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FIRST ANNUAL REPORT ON CARCINOGENS

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VOLUME 1

DEPARTMENT OF HEALTH & HUMAN SERVICES

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FIRST ANNUAL REPORT ON CARCINOGENS

Pursuant to Section 301(b) (4) of the
Public Health Service Act as Amended
by Section 262, PL 95-622

JULY 1980

VOLUME I

Department of Health and Human Services

Prepared by
National Toxicology Program
U.S. Public Health Service

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FIRST ANNUAL REPORT ON CARCINOGENS

EXECUTIVE SUMMARY

This First Annual Report on Carcinogens is issued by the Secretary of the Department of Health and Human Services (DHHS) pursuant to Public Law 95-622 which was signed into law on November 8, 1978.* Section 262, Part E, requires that the Secretary of the Department of Health, Education, and Welfare (now DHHS) publish an annual report containing ". . . a list of all substances (i) which either are known to be carcinogens or which may reasonably be anticipated to be carcinogens and (ii) to which a significant number of persons residing in the United States are exposed. . . ."

Additionally, these annual reports are to provide information on the nature and degree of exposures to such carcinogens and the extent to which Federal regulations are effective in reducing the risk to the public health from exposures to these substances.

This first report discusses a group of 26 chemicals and processes reviewed by panels of international experts and initially found to be associated with the induction of cancer in man.** It also includes information on exposures and on the status of existing regulations of these chemicals.

With this first report, the DHHS begins the long and difficult process of systematically gathering and analyzing significant information about cancer-causing agents in the environment. Further reports will play an important role in informing the public, and those who determine regulatory policy, about the potential human health risks from carcinogens.

Because this is the first report of this type, there are a number of limitations that impeded its full development.

Science and society have not arrived at a final concensus on the definition of carcinogen either in human population or in experimental animals. Scientific judgment plays an important role in the final decision on whether a substance is a carcinogen where test results are unclear. This judgment rests on a knowledge base that is fluid and evolving. However, prudent public health policy dictates that regulation of possibly hazardous substances should not have to wait until there is human evidence of cancer. It is important that evidence from experimental animals be used because society cannot wait until cancer occurs in a population to learn that there is a serious health problem.

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* An amendment to Section 301(b)(4) of the Public Health Service Act.

** See page 3 of the report.

In the past 2 years, progress has been made in defining a carcinogen for regulatory purposes in order to protect the public health. The Interagency Regulatory Liaison Group (IRLG) and the Regulatory Council have issued policy statements endorsing the principle that positive, well-conducted studies on laboratory animals provide strong presumptive evidence of human carcinogenicity. Furthermore, epidemiological evidence--that is statistical studies of human populations--can be used to confirm carcinogenicity in man. These principles have also been incorporated in the Occupational Safety and Health Administration's recently issued cancer policy.

Because of the pioneering nature of this report, only a limited number of carcinogens have been included. The fact that a substance is not included does not mean that it is not a carcinogen. There are more substances than those reported on here which may represent potential health risks to the population. Some of these cancer-causing chemicals are already subject to regulation. The 26 chemicals included represent substances historically viewed as associated with cancer in man. Future reports will deal with chemicals more recently identified as carcinogens, usually through animal studies.

This report will be expanded as the Environmental Protection Agency (EPA) uses its authority under the Toxic Substances Control Act of 1976 (TSCA) to require testing of newly introduced chemicals and of significant new uses of existing chemicals.

The National Toxicology Program will also play a key role in expanding the scope of this report as test results are reported on existing chemicals whose testing has not been required by TSCA.

Estimating the number of people exposed and the nature or route and intensity of exposure remains a difficult problem. Currently, it is difficult, if not impossible, to obtain accurate production and use volumes for most chemicals. In the future, information collected by EPA under TSCA will assist in obtaining this information. But at the moment much of the exposure information is at best an educated guess.

Perhaps the most difficult task is to estimate the effectiveness of Federal regulations in reducing risk. One reason for this difficulty is that virtually all Federal laws concerned with reducing risk to carcinogens have been enacted within the last decade. Thus, given the long period between exposure to a carcinogen and onset of disease, it is difficult to establish the extent to which more stringent regulations of the past decade have reduced risk. Another is that it is particularly difficult to obtain information on past exposure levels to use as a baseline for estimating future risk reduction.

There are two possible ways in which risk reduction might be estimated. The first involves the assumption that risk of cancer is proportional to exposure to the carcinogen. This model assumes extensive information on past and present exposure levels and implicitly assumes that all workplaces are in compliance with the regulations. Information from dose-response studies in laboratory animals can be used to strengthen these estimates; such information has been available only rarely.

Currently, attention is focused on a second way to estimate risk reduction. This method involves applying the results of laboratory animal studies to human health, and discussion focuses on the extent to which such laboratory animal studies are applicable and meaningful in estimating human health risk. As consensus develops, future annual reports will discuss findings in this area.

Categories of Chemicals Catalogued

Lorenzo Tomatis, Director of the Division of Chemical and Biological Carcinogenesis at the International Agency for Research on Cancer (IARC), and colleagues (Cancer Research 38:877, April 1978) divided the chemicals or industrial processes evaluated in the first 16 monographs of IARC into eight major use-exposure categories. In the following discussion, the 26 chemicals and industrial processes fall into five of these categories; namely, naturally occurring substances, industrial chemicals, industrial processes, industrial by-products and pharmaceuticals.

1. Naturally Occurring Chemicals

The aflatoxins are the only chemicals on this list where exposure is principally from natural sources. Other chemicals on this list also exist in nature, to some degree, but their principal source of exposure is elsewhere.

2. Industrial Chemicals

This category of industrial chemicals includes: 4-aminobiphenyl; arsenic; asbestos; auramine; benzene; benzidine; bis(chloromethyl)ether and chloromethyl methyl ether; mustard gas; 2-naphthylamine; soots, tars, and oils; and vinyl chloride. All of these, except auramine, were classified by the 1979 IARC Ad Hoc Working Group as being carcinogenic for humans. Auramine was classified as probably carcinogenic for humans with "lower degrees of evidence." The 1979 IARC Ad Hoc Working Group then noted that the manufacture of auramine is carcinogenic to humans.

3. Industrial Processes

The industrial processes discussed here include: cadmium and cadmium compounds, chromium and chromium compounds, hematite, and nickel and nickel compounds. All but cadmium and cadmium compounds and hematite were considered by the 1979 IARC Ad Hoc Working Group to be carcinogenic for humans. Cadmium and cadmium compounds were considered to be probably carcinogenic for humans with "higher degrees of evidence." Hematite could not be classified as to its carcinogenicity for humans. However, underground hematite mining was considered to be carcinogenic for humans.

4. Industrial By-Products

The only industrial by-products considered in this report are the isopropyl oils. These oils are formed during the manufacture of isopropyl alcohol. The 1979 IARC Ad Hoc Working Group stated that the isopropyl oil could not be classified as to its carcinogenicity for humans. Manufacture of isopropyl alcohol by the strong acid process was classified as carcinogenic for humans.

5. Pharmaceuticals

This category includes: N,N-bis(2-chloroethyl)-2-naphthylamine, chloramphenicol, cyclophosphamide, diethylstilbestrol (DES), melphalan, oxymetholone, phenacetin, and phenytoin. The 1979 IARC Ad Hoc Working Group classified N,N-bis(2-chloroethyl)-2-naphthylamine, diethylstilbestrol, and melphalan, and as carcinogenic for humans. Cyclophosphamide was classified by the committee as probably carcinogenic for humans with "higher degrees of evidence" while oxymetholone and phenacetin were classified as probably carcinogenic for humans with "lower degrees of evidence." The committee could not classify chloramphenicol and phenytoin with respect to their carcinogenicity for humans due to the inadequacy of the available data.

Section A provides the context of this report. Section B provides the basis for the selection of the 26 chemicals, and their classification. Section C, the introduction, provides the basis for the pertinent data with respect to each of these chemicals. The Regulatory Council's statement on "Priority Setting for Regulating Chemicals" and the "Mission Statements of Federal Agencies (participating in the report) Having Primary Roles in the Regulation of Chemical Carcinogens" are contained in Section D. The tabular summary of Agency submissions is contained in Section E. Section F contains lists of requests for testing made to the Department of Health and Human Services and their disposition. The appendix is divided into three parts: I. Agency Elaborative Statements on Regulatory Mission; II. Glossary of Abbreviations; and III. List of Participants.

FIRST ANNUAL REPORT ON CARCINOGENS

A. Foreword

Cancer, the Nation's number two killer, will take the lives of almost 400,000 Americans this year. Cancer is associated with great financial loss as well as suffering to individuals and their families. Rough estimates of its total direct and indirect costs to the Nation, including medical costs and lost productivity, range up to $30 billion a year.

Americans have become increasingly concerned about the risk of environmental and occupational cancer. As one by one new chemical agents in our air, water, and food, and other factors such as smoking, have been identified as possible cancer-causing agents, the public has turned toward the government for answers. Clearly the public wants to know which of these agents in the workplace and in the general environment are serious hazards, and how well the government is protecting the public health by controlling these agents.

The systematic identification of chemical carcinogens by the government began, not as a regulatory tool, but rather as a research effort conducted primarily by the Carcinogenesis Testing Program at the National Cancer Institute, National Institutes of Health, of the Department of Health, Education, and Welfare, now the Department of Health and Human Services. Accordingly, priorities for testing were determined more often by research interests than by particular regulatory needs.

With this First Annual Report on Carcinogens, the Department of Health and Human Services (DHHS) begins the long and difficult process of systematically gathering and analyzing significant information about cancer-causing agents in the environment. Further reports will be issued annually and will play an important role in informing and educating the public, and those who determine regulatory policy, about the potential human health risks from carcinogens.

Although various Federal Agencies have been collecting information on and regulating carcinogens for several years, this is the first time that an attempt has been made to bring these data together in one report as intended by Congress. Thus, because of its pioneering nature, this first report is necessarily limited in scope to only a limited number of carcinogens. The fact that a substance is not included in this first annual report does not mean that it is not a carcinogen. There are more substances than those included which may represent potential health risks to the population.

Critical to a judgment of the risk posed by a particular carcinogen is an understanding of how people can be exposed to it. As this first report is written, exposure data are imperfect. However, as subsequent annual reports are issued, this list, its exposure data and risk assessments, will become more sophisticated.

Science and society have not arrived at a final consensus on the definition of a carcinogen either in human populations or in the experimental animals which are used to test for cancer-causing potential in man. However, in the past 2 years, progress has been made in defining these questions for regulatory purposes to protect the public health. Two United States government reports have dealt with this important issue: the Interagency Regulatory Liaison Group's (IRLG) risk assessment document[1] and the Regulatory Council's carcinogen policy.[2] Both of these reports support the principle that positive, well-conducted studies on laboratory animals provide strong evidence that a substance may be presumed to be a human carcinogen and that epidemiological evidence--that is, statistical studies made of human populations--can be used to confirm the carcinogenicity of substances in man. The Occupational Safety and Health Administration (OSHA) adopted the same principles in its generic cancer policy.[3] Moreover, the International Agency for Research on Cancer (IARC), part of the World Health Organization, has spelled out its definitions in a recent document, IARC Supplement 1, 1979.

Although scientific judgment in the area of carcinogenesis is fluid and evolving, these definitions will influence the inclusion of chemicals in this and future reports. In response to growing scientific knowledge of their possible hazard, as several Federal Agencies are developing policies to limit exposure to carcinogens, this annual report becomes an important tool in public health protection.

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[1] The IRLG, established to coordinate Federal policy toward health hazards, consists of the Consumer Product Safety Commission (CPSC), the Department of Agriculture's Food Safety and Quality Service (FSQS), the Environmental Protection Agency (EPA), the Food and Drug Administration (FDA), and OSHA. The document is entitled "Scientific Bases for Identification of Potential Carcinogens and Estimation of Risks", was published in the Federal Register on July 6, 1979.

[2] The Regulatory Council is a group of 18 executive and 18 independent agencies which monitors and coordinates regulatory activity. Its "Statement on Regulation of Chemical Carcinogens" was published in the Federal Register on October 17, 1979 (see page 60038-60041).

[3] "Identification, Classification and Regulation of Potential Carcinogens" was published in the Federal Register, January 22, 1980.

The language of the statute calling for this report requires the inclusion of ". . . all substances which either are known to be carcinogens or . . . may reasonably be anticipated to be carcinogens. . . ." The legislation does not require scientific proof of carcinogenicity for a substance to be included on the list.

Twenty-six compounds, most of which were identified through scientific consensus many years ago, have been included in this first report. The data on these chemicals have been peer reviewed and published in the first of the 16 IARC monographs. Thus, the regulatory and scientific communities were given sufficient lead time so that when appropriate legislation was enacted, they could respond--the regulators with regulatory strategies and the scientific community with strong scientific consensus.

Many of the 26 compounds also were first associated with cancer in human populations. Prudent public health policy, as is demonstrated by recent trends in regulatory legislation, is designed to prevent human exposure to hazardous substances. We do not want to wait until human disease occurs before we learn there may be a problem. But the realization that properly conducted laboratory animal studies do predict which chemicals can cause cancer in human populations has evolved only in the last decade.

It is important to note that the chemicals discussed in detail in this report do not represent the total of all substances confirmed or suspected to be potential carcinogens. The National Institute for Occupational Safety and Health (NIOSH) has published a list of 34,000 toxic substances, 2,330 of which have one or more unevaluated studies dealing with tumorigenicity.[4] The participating regulatory agencies have already regulated additional chemicals on the basis of their carcinogenicity not included in the 26 chemicals discussed herein; OSHA is preparing a list of candidate substances requiring further analyses before moving to regulation. Thus, this report must be viewed as one part of the total public and private effort to identify and control chemical carcinogens. These 26 chemicals represent those substances that have been historically viewed as associated with cancer in man. Future annual reports will deal primarily with chemicals more recently identified as carcinogens, usually through animal studies.

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[4] "Registry of Toxic Effects of Chemical Substances", NIOSH, 1978. Approximately a third of these 2,330 substances are possible carcinogens.

While from the standpoint of public health protection, it is extremely important that regulatory definitions of carcinogens such as those of the IRLG, OSHA, and the Regulatory Council are being established; scientific judgment will continue to play an important role in analyzing the results of animal studies.

These annual reports will be broadened to include new substances as the EPA its authority under the Toxic Substances Control Act of 1976 (TSCA) to require safety testing on newly developed chemicals and on significant new uses of existing chemicals. Data from TSCA studies will be incorporated into future reports.

The National Toxicology Program (NTP)[5] will also play a key role in increasing the scope of these annual reports by testing existing chemicals. NTP is also active in developing new, less expensive and quicker test methods than the standard animal bioassay. When perfected, these methods will help test even more chemicals.

Estimating Exposure

Estimation of exposure--which involves estimating the number of people exposed and the nature or route and intensity of exposure--is another difficult problem. Currently, it is difficult, if not impossible, to obtain accurate production and use volumes for most chemicals. In future years, the information collected by the EPA under TSCA will assist in obtaining this information.

Data regarding exposure levels in occupational and envionmental settings are certainly not as complete as we would like. This Department's National Occupational Hazard Survey (NOHS), conducted from 1972 to 1974, gave good information on the number of workers exposed, as well as the first information, in a qualitative sense, on the broader aspects of occupational exposure levels. The forthcoming NOHS II should yield important new information with respect to more recent exposure. Subsequent annual reports on carcinogens will explore other available data bases and their strengths and limitations. But at the moment much of the exposure information is at best an educated guess.

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[5] NTP's Executive Committee includes FDA, OSHA, CPSC, EPA, NIOSH, the National Cancer Institute (NCI), and the National Institute of Environmental Health Sciences (NIEHS).

Reducing Risk

Perhaps the most difficult task is to estimate the effectiveness of Federal regulations in reducing risk. One reason for this difficulty is that virtually all Federal laws concerned with reducing risk to carcinogens have been enacted within the last decade. Thus, given the long period between exposure to a carcinogen and onset of disease, it is difficult to establish the extent to which more stringent regulations of the past decade have reduced risk. Another is that it is particularly difficult to obtain information on past exposure levels to use as a baseline for estimating future risk reduction.

The regulation of asbestos in the workplace provides a good example of the problem. In 1969 under the Walsh-Healy Act, which regulates only firms with government contracts, the standard for permissible exposure was 12 fibers of asbestos per cubic centimeter (cc). Under the OSHA Act, this standard was reduced to 5 fibers/cc in 1972 and 2 fibers/cc in 1976. On April 17, 1980, a joint NIOSH-OSHA Working Group recommended that all non-essential uses of asbestos be eliminated and that a public health program to reduce human exposures be implemented. The extremely high risk to workers heavily exposed prior to 1969 is well known, but data on exposure levels in the forties, fifties, and sixties are fragmentary. Mesothelioma (primarily an asbestos-induced cancer) and lung and other cancers, whose incidence is increased by asbestos exposure, generally take 20-40 or more years to develop and become apparent. Therefore, we will not know until early in the next century the extent to which the series of exposure reductions in seventies have reduced the cancer risk of those exposed to asbestos.

There are two possible ways in which risk reduction might be estimated. The first involves the assumption that risk of cancer is proportional to exposure to the carcinogen. This model assumes extensive information on past and present exposure levels and implicitly assumes that all workplaces are in compliance with the regulations. Information from dose-response studies in laboratory animals can be used to strengthen these estimates; such information has been available only rarely.

Currently, attention is focused on a second way to estimate risk reduction. This method involves applying the results of laboratory animal studies to human health, and discussion focuses on the extent to which such laboratory animal studies are applicable and meaningful in estimating human health risk. As consensus develops, future annual reports will discuss findings in this area.

B. Introduction

The Community Mental Health Centers Act, Amendments, Section 262, PL 95-622, Part E, signed November 8, 1978, establishes a requirement that the Secretary of the Department of Health, Education and Welfare (DHEW) (now the Department of Health and Human Services (DHHS)) publish an annual report which contains:

> "(A) a list of all substances (i) which either are known to be carcinogens or may reasonably be anticipated to be carcinogens and (ii) to which a significant number of persons residing in the United States are exposed;
>
> "(B) information concerning the nature of such exposure and the estimated number of persons exposed to such substances;
>
> "(C) a statement identifying (i) each substance contained in the list under subparagraph (A) for which no effluent, ambient, or exposure standard has been established by a Federal agency; and (ii) for each effluent, ambient, or exposure standard established by a Federal agency with respect to a substance contained in the list under subparagraph (A), the extent to which, on the basis of available medical, scientific, or other data, such standard, and the implementation of such standard by the agency, decreases the risk to public health from exposure to the substance; and
>
> "(D) a description of (i) each request received during the year involved--
>
> > "(I) from a Federal agency outside the Department of Health, Education and Welfare for the Secretary, or
> >
> > "(II) from an entity within the Department of Health, Education and Welfare to any other entity within the Department
>
> to conduct research into, or testing for, the carcinogenicity of substances to provide information described in (ii) of subparagraph (C), and (ii) how the Secretary and each such other entity, respectively, have responded to each request."

The National Toxicology Program (NTP) was delegated the responsibility within DHHS for implementation of this Section. The intent of this legislation and the first annual report is to better focus and coordinate the Federal agencies' efforts to protect the public health from carcinogenic agents, to provide information that will be useful to regulatory agencies in increasing the degree of public health protection, and to provide a source of information for the public and policy makers in both the private and public sectors. Agencies participating in this effort include:

Center for Disease Control/National Institute for Occupational Safety and Health (CDC/NIOSH)

Consumer Product Safety Commission (CPSC)

Environmental Protection Agency (EPA)

Food and Drug Administration (FDA)

National Institutes of Health/National Cancer Institute (NIH/NCI)

National Institutes of Health/National Institute of Environmental Health Sciences (NIH/NIEHS)

Occupational Safety and Health Administration (OSHA)

A key issue in the development of this first report was arriving at a consensus definition of the term carcinogen. In the interest of expeditiously initiating issuance of the first report, the decision was made to proceed with the list of chemical carcinogens described in the IARC monographs (Volumes I through XVI), Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man.

In 1971, IARC, a World Health Organization agency based in Lyon, France, began a program to prepare monographs on the evaluation of the carcinogenic risk of chemicals to man.

The following, taken from IARC Monograph Supplement 1 (1979) is of interest:

> "Selection of chemicals for evaluation is based on two criteria: firstly, there are data related to the carcinogenicity in humans or experimental animals; and secondly, there is evidence of human exposure.
>
> "Inclusion of a chemical in the monographs does not imply that it is a carcinogen, only that the published data have been examined. Equally, the fact that a chemical has not yet been evaluated in a monograph does not mean that it is not carcinogenic."

The fact that these monographs result from peer review of the existing data was the key factor in selecting the IARC list for the first annual report.

The approach for this first annual report is based on the IARC monograph program between 1971 and 1977 as summarized in the paper of Tomatis et al.: "Evaluation of the Carcinogenicity of Chemicals: A Review of the Monograph Program in the International Agency for Research on Cancer (1971 to 1977)," Cancer Research, 38: 877-885, April, 1978. This paper reported that "26 chemicals or industrial processes have been associated with, or are strongly suspected to be associated with, the occurrence of cancer in humans." These evaluations were "based on evidence provided by epidemiologic studies or case reports, and experimental evidence of carcinogenicity was not used in the formulation." These 26 chemicals or industrial processes associated with human cancer are the subject of the first annual report.

Subsequent to that article, the IARC Monograph Supplement 1, Chemicals and Industrial Processes Associated with Cancer in Humans, September, 1979, reviewed IARC Monographs, Volumes 1-20. The 1979 IARC Ad Hoc Working Group utilized case reports or epidemiological studies. Animal studies also were included in these evaluations as well as data that had become available since the publication of the relevant monograph.

The supplement established the following categories:

"Group 1: The chemical, group of chemicals, or industrial process is carcinogenic for humans. This category was used only when there was sufficient evidence to support a causal association between the exposure and cancer."

"Group 2: The chemical or group of chemicals is probably carcinogenic for humans."

"Group 2A: higher degrees of evidence"

"Group 2B: lower degrees of evidence"

"The data from experimental animal studies played an important role in assigning chemicals to category 2, and particularly to those in group B."

"Group 3: The chemical or group of chemicals cannot be classified as to its carcinogenicity for humans."

The list of the 26 IARC reviewed chemicals or industrial processes included in this report and their classification in Supplement 1 follows:

	Substances	Monograph Volume and Page	IARC Supplement 1 Classification
1.	aflatoxins	1, 145; 10, 51	2A
2.	4-aminobiphenyl	1, 74	1
3.	arsenic and inorganic arsenic compounds	2, 48	1
4.	asbestos	2, 17; 14 (entire volume)	1
5.	auramine	1, 69	2B
6.	benzene	7, 203	1
7.	benzidine	1, 80	1
8.	N,N-bis(2-chloroethyl)-2-naphthylamine	4, 119	1
9.	bis(chloromethyl)ether	4, 231	1
10.	cadmium and cadmium compounds	2, 74; 11, 39	2A
11.	chloramphenicol	10, 85	3
12.	chloromethyl methyl ether	4, 239	1
13.	chromium	2, 100	1
14.	cyclophosphamide	9, 135	2A
15.	diethylstilbestrol	6, 55	1
16.	hematite and iron oxide	1, 29	3
17.	isopropyl oils	15, 223	3
18.	melphalan	9, 167	1
19.	mustard gas	9, 181	1
20.	2-naphthylamine	4, 97	1
21.	nickel and nickel compounds	2, 126; 11, 75	1
22.	oxymetholone	13, 131	2B
23.	phenacetin	13, 141	2B
24.	phenytoin and phenytoin sodium	13, 201	3
25.	soots, tars, and oils	3, 22	1
26.	vinyl chloride	7, 291; 19, 377	1

It should be noted that the IARC reports for each chemical include analyses of world-wide production, use and exposure (see Appendix). Since some of these data may not be appropriate to the United States, they have not been included in the report. The report is based on the participating agencies' submissions of information relevant to Agency missions. The Agency positions in this area will be developed in the Appendix I: Agency Elaborative Statements on Regulatory Mission.

The summary of Agency submissions appears in Section F. Estimates of decrease of risk that participating Agencies were able to make as requested in the Act appear in Section E, under "Effect of Regulation and Other Actions."

Section E of this report includes a response to Section E of the Act requiring a description of information requests from a Federal Agency outside the DHHS or within DHHS to any other entity within DHHS to conduct research into, or testing for, the carcinogenicity of substances, and the responses made to such requests. Volume II contains IARC selected data, and the full Agency data submissions as received.

The second annual report will review (1) additional category 2A and 2B compounds; (2) selections from the IARC list of animal carcinogens; (3) those chemicals for which regulation has been completed and is based on the carcinogenicity of the chemical; and (4) those chemicals for which regulation has been formally initiated and is based on the carcinogenicity of the chemical.

C. Categories of Chemicals Catalogued

Tomatis et al., (Cancer Research 38: 877, April 1978), divided the chemicals or industrial processes evaluated in the first 16 of the IARC monographs into eight major use-exposure categories. In the following discussion, the 26 chemicals and industrial processses fall into five of these categories; namely, naturally occurring substances, industrial chemicals, industrial processes, industrial by-products and pharmaceuticals. Summary data relating to use and exposure, to evidence of carcinogenicity, and to kind and effectiveness of regulations in reducing exposure are provided.

1. Naturally Occurring Chemicals

The aflatoxins are the only chemicals on this list where exposure is principally from natural sources. Other chemicals on this list also exist in nature, to some degree, but their principal source of exposure is elsewhere. For example, soots are produced by fires in nature, as well as by those of human origin. Carcinogenic arsenic and metal compounds exist in rocks and soils and therefore may be present at low levels in food. For these, however, the highest level of exposure results from human activities. Therefore, these chemicals or industrial processes will be discussed in their appropriate category later in the report.

Aflatoxins

Aflatoxins are produced by some types of fungi that grow on food where high temperatures and high humidity favor their formation. Rapid post-harvest drying of crops and storage at low humidity are the most effective prevention and control measures. Grains, peanuts, tree nuts, and cotton seed meal or oil are among the more common substrates for the growth of these fungi. Meat, eggs, milk of livestock and other edible products from animals that consume aflatoxin-contaminated feeds may also contain aflatoxins.

Animal studies have shown that aflatoxins induce cancer in monkeys, marmosets, tree shrews, rats, mice, ducks and fish. Relatively high levels of aflatoxins have been found in the diet of human populations in Africa and Asia that have a high incidence of liver cancer. The 1979 IARC Ad Hoc Working Group which reviewed the IARC monographs classified the aflatoxins as probably carcinogenic for humans with "higher degrees of evidence."

Aflatoxin control is based on the authority of the FDA to limit the levels of environmental contaminants that are permitted in food. Complete elimination of aflatoxin contamination of food is neither technically nor economically feasible. Since only a small proportion of some foods are heavily contaminated while a larger proportion have very low levels of contamination, increasingly strict limits on aflatoxins in food would require elimination from the market place of an increasing proportion of these foods. The FDA has lowered the maximum amount allowed in food products as analytic methods of detection and methods of control have improved. An upper limit of 20 parts per billion (ppb) in shelled peanuts and peanut products and 0.5 ppb in milk is now in effect. A proposal, soon to be implemented, will lower the tolerance in peanut products to 15 ppb. The total amount of aflatoxins in the diet of Americans is estimated to be from 0.148 to 0.490 micrograms per person per day.

2. Industrial Chemicals

This category is composed of chemicals or mixtures of chemicals for which the major source of exposure results from industrial activity. The potential exposure hazard extends to uses, as well as to manufacture or production. It should be noted, however, that soots, tars, and oils are complex and variable mixtures, some of which may be carcinogenic and others not. The categories "Industrial Chemicals" and "Industrial Processes" (discussed subsequently) were those used by Tomatis et al. It is less clear for an industrial process which particular chemical is responsible for the carcinogenic hazard.

This category of industrial chemicals includes: 4-aminobiphenyl; arsenic; asbestos; auramine; benzene; benzidine; bis(chloromethyl) ether and chloromethyl methyl ether; mustard gas; 2-naphthylamine; soots, tars, and oils; and vinyl chloride. All of these, except auramine, were classified by the 1979 IARC Ad Hoc Working Group as being carcinogenic for humans. Auramine was classified as probably carcinogenic for humans with "lower degrees of evidence." The 1979 IARC Ad Hoc Working Group then noted that the manufacture of auramine is carcinogenic to humans.

4-Aminobiphenyl

This chemical, formerly used as a rubber antioxidant, has no commercial use in the United States today. It may be present, however, as a contaminant in diphenylamine which is used in the manufacture of dyes. As a result, there is an exposure potential to approximately 1,000 workers to 4-aminobiphenyl.

Carcinogenicity for the urinary bladder, liver, and other organs has been experimentally demonstrated in dogs, rats, mice, and rabbits. When it was used commercially, those workers exposed to 4-aminobiphenyl were found to have a high incidence of bladder cancer.

OSHA issued an emergency temporary standard in May 1973, followed by a final standard in February 1974, for control of worker exposure to diphenylamine by reducing exposure to the lowest feasible level. This was accomplished by prohibiting operations in open vessels, requiring use of exhaust fans, protective clothing, and respirators; and controlling plant contamination.

Arsenic

Production of arsenic and arsenical compounds in the United States is about 70 million pounds, while an additional 20 million pounds are imported. Occupational use of arsenic or materials contaminated with arsenic has the potential for exposing 545,000 workers, resulting from the manufacture or use of arsenic compounds in pesticides, glass, ceramics, paints, dyes, and preservation of hides. Arsenic is also present in the ores of a number of metals, resulting in potential exposure of workers and the environment from mining and smelting. In addition to occupational exposure, most of the population are exposed to low levels in food. Arsenic is found naturally in ocean fish and shellfish and trace residues may remain in tissues of livestock administered arsenical drugs and feed additives.

Evidence of the carcinogenicity of arsenic comes only from human studies. Skin cancer was found to be more common than usual among the following groups: patients receiving arsenic-containing drugs; inhabitants of areas with high levels of arsenic in the drinking water; and workers exposed to arsenic in several industries. There is also evidence suggesting that arsenic may be carcinogenic for the lung. Animal studies have not yet given convincing evidence of carcinogenicity. Additional experiments are in progress.

Levels in workplace air have been regulated since 1952. Current limits for inorganic arsenic, issued as a final standard by OSHA in June 1978, are 10 mg (μg) per cubic meter of air for eight hours. EPA limits arsenic in drinking water to a maximum of 0.05 mg per liter, and has proposed water quality criteria for total arsenic. Effluent guidelines control environmental release for certain industrial categories. EPA has issued a rebuttable presumption against the registration of eleven inorganic arsenical pesticides, a step in the possible banning or limiting of their use. FDA estimates that natural sources contribute 0.02 mg per day to the diet per person.

Asbestos

Asbestos is so widely used that our entire population is exposed to some level. Heavy exposure has occurred in the past to workers involved in the mining and milling of asbestos, the manufacture of asbestos-containing materials, application of asbestos insulation, and renovation of buildings and ships that used asbestos insulation. Families of workers have been exposed to asbestos-contaminated clothing that was brought home for cleaning. The domestic consumption of asbestos in 1976 was reported by the Bureau of Mines to be 726,300 short tons. About 2,500,000 workers have some occupational exposure during their work day. Exposure data relevant to consumer product uses of asbestos are now being collected by CPSC.

The general population is exposed to a large number of asbestos-containing products (listed in the CPSC portion of Volume II of this report) from which asbestos fibers may be released into the environment as a result of wear or deterioration. Asbestos that had been sprayed on interior surfaces of buildings as a fire retardant or decoration again may result in contaminating the inside air. The amount of asbestos to be found in food is assumed to be small, but confirmation is handicapped by lack of suitable monitoring techniques Asbestos fibers have been found in the waters of rivers and lakes, particularly in asbestos mining areas.

Past occupational inhalation exposure to asbestos has been shown to increase the incidence of lung cancer. The effect is enhanced in those asbestos workers who also were cigarette smokers.

Asbestos exposure also causes mesotheliomas, malignant tumors of the lining of the chest or abdominal cavities. These ordinarily very rare tumors have been found at significantly higher rates in asbestos workers, also in their families, and are considered an asbestos specific disease. Cancer of the gastrointestinal tract and the larynx have also been shown to be increased in previously exposed workers. The carcinogenicity of asbestos for the lung and mesothelium has been confirmed by experiments in rats, mice, rabbits, and hamsters.

In 1976, OSHA reduced the concentration of asbestos fibers permitted in workplace air to two fibers per cc, the current standard. Primary reliance for control is based on engineering measures. The use of asbestos in clothing not designed for protection against thermal injury was banned by FDA in 1972. (Authority for ensuring compliance with this action has since been transferred to CPSC.) The banning by CPSC of asbestos in patching compounds and in gas fireplaces in 1977 prevented additional exposure of several million consumers who had already been exposed to asbestos from these sources. U.S. manufacturers of hand-held hair dryers cooperated with CPSC by voluntarily ceasing to use asbestos liners. This voluntary program resulted in the return to the manufacturer or the repair of 2 million of these dryers by January 1980. EPA proposed asbestos water quality criteria in October 1979. Air emissions are controlled through limits on visible emissions, labeling requirements and practice controls because of the lack of specific monitoring techiques for asbestos. A voluntary program launched by EPA with public schools is removing or encapsulating sources of asbestos release and exposure in school buildings. EPA and CPSC published advanced notices of proposed rulemaking stating their intent to further regulate the uses of asbestos.

Recently (April 1980) a NIOSH/OSHA work group reviewed the most recent scientific information and recommended that a new standard for asbestos be promulgated. Recommendations included reduction of the current environmental limit and elimination of non-essential asbestos exposures with substitution of less hazardous alternatives.

Auramine

Auramine is not manufactured in the United States, but about 500 pounds are imported annually. It is used industrially as a dye or dye intermediate for coloring textiles, paper and leather. About 3,000 workers in these industries may be exposed to auramine. Low-level dermal exposure may occur from use of these products by consumers.

Animal experiments, using commercial auramine of unknown purity, resulted in the induction of liver cancer in rats and mice. Workers engaged in the manufacture of auramine in open vessels had an increased incidence of bladder cancer. The workers, however, also were exposed to other chemicals. The 1979 IARC Ad Hoc Working Group classified auramine itself as probably carcinogenic for humans with "lower degrees of evidence."

The manufacture or use of auramine is subject to OSHA's general duty clause requiring that places of employment be "free from recognized hazards that are likely to cause death or serious harm" to employees.

Benzene

More than 16 billion pounds of benzene are produced each year in the United States and almost 3 billion pounds are imported. Nearly three million workers may be exposed, either through direct use of benzene or through the production and use of substances containing or contaminated with it. About 20 million people are estimated to be exposed to consumer products containing low levels of benzene as a contaminant. Benzene occurs in petroleum and coal-tar distillates. It has been used as a solvent in paints, adhesives, dyes, and in chemical laboratories. It is used in the manufacture of other chemicals, plastics, detergents, and certain pesticides. Benzene, alkanes, toluene, and xylene are added to most grades of gasoline. Benzene is most volatile of these aromatic hydrocarbons; this results in a benzene exposure not only to many thousands of gasoline filling station attendants, but to the innumerable motorists who are currently using self-service gasoline pumps. Depending upon the grade of gasoline and time of year, between one and four percent benzene is added to gasoline.

Reports of defects in blood cell formation and of leukemia among individuals who worked with benzene have appeared in medical literature since 1929. This evidence has been greatly strengthened by more recent epidemiological studies of benzene-exposed workers that support the conclusion that benzene causes leukemia in humans. While published animal experiments have not demonstrated carcinogenicity, those published so far have been inadequate. New studies are now underway in several laboratories.

OSHA's 1971 standard limited benzene to 10 ppm in the air for an eight hour time-weighted average (TWA). This was lowered in 1977 by an emergency temporary standard to a 1 ppm TWA with a maximum of 5 ppm for 15 minutes. A final standard establishing a permissible exposure limit of 1 ppm eight-hour TWA with a 5 ppm upper level limited to five minutes was stayed in court and is now under appeal. The Consumer Product Safety Commisson now requires warning labels on household products containing more than five percent benzene. Safety packaging is required for solvents for paints or for other similar surface coating materials that contain at least ten percent benzene. In addition, the Commission has proposed a ban on the intentional use of benzene in consumer products and in products containing 0.1 percent or more of benzene by volume as a contaminant. Although a final regulation has not been issued, intentional use of benzene in consumer products has essentially been eliminated. Between 400,000 and 800,000 persons are no longer exposed as a result. EPA has proposed water quality standards for benzene and is working on air emission standards.

Benzidine

The use of benzidine, which was formerly produced in the United States at levels of many millions of pounds per year for the manufacture of dyestuffs, has fallen dramatically because of classic studies of carcinogenicity for humans and experimental animals. EPA figures indicate that only 500 pounds per year are now produced in the United States and none is imported. Production dropped substantially since EPA promulgated toxic pollutant effluent standards in 1977. Nevertheless, benzidine is used rather widely in small amounts in medical laboratories, and it is a contaminant in benzidine-based dyes. Accordingly, it is estimated that 86,000 workers may be exposed to some level of benzidine. In 1977, 1.4 million pounds of benzidine-based dyes were produced in the United States and 76,300 pounds were imported. "Benzidine-based" means that the chemical structure of benzidine is included as part of a larger molecule, even though the method of synthesis may not have required use of benzidine as a starting material. In addition to the problem of contamination of these dyes with free benzidine, there are recent data suggesting that some of the dyes may be metabolized inside the body, releasing free benzidine from the larger molecule.

Studies on occupationally exposed persons indicate that benzidine causes bladder cancer in humans. In experimental studies, it has induced liver and other cancers in rats, liver cancer in mice and bladder cancer in dogs.

EPA control activities for benzidine include both the 1977 toxic pollutant effluent standards and the water quality standards proposed in October 1979. CPSC reports that no insoluble benzidine-based pigments have been produced or imported into the United States since 1974, and that benzidine-based dyes are no longer being used in fabric dyes marketed for use by consumers. The Commission has received a petition requesting that benzidine-based dyes be banned for use in consumer products and is considering various regulatory alternatives. The OSHA standard, adopted in 1974, prohibits use of benzidine in open vessels and requires contamination control, use of exhaust fans, protective clothing and devices, and warning signs and labels.

Bis(chloromethyl)Ether and Chloromethyl Methyl Ether

These chemicals are the dichloro and monochloro derivatives of dimethyl ether. Technical grades of chloromethyl methyl ether (CMME) are contaminated with 1-8 percent bis(chloromethyl)ether (BCME). These chemicals are used in the synthesis of other chemicals and in the manufacture of plastics and ion exchange resins. Domestic production of BCME is reported by EPA to be 550,000 pounds. There are four producers of CMME in the U.S., but the amount produced has not been reported. No estimates of the number of workers exposed are available. Environmental exposure through water pollution should be small, since both chemicals rapidly break down in water. Breakdown in air would be less rapid, however. There is also the possibility of very low-level exposure to perhaps 100,000 dental patients per year from metabolism of some restorative materials. Significant concentrations of BCME are formed whenever formaldehyde, water and hydrogen chloride vapors are mixed at room temperature even in low concentrations. This potential route of exposure to BCME should not be overlooked for those situations where the potential for this reaction exists.

BCME has been studied in experiments in rats and mice. It produces tumors at the site of application, whether to the skin, subcutaneous tissues or respiratory tract. Technical grade CMME, which is contaminated with BCME, has also produced tumors in tests in mice but is less active than a similar amount of BCME. Epidemiologic studies have demonstrated an increased risk of lung cancer in workers exposed to BCME and technical grade CMME. The carcinogenicity of BCME is well established. There is debate, however, whether the carcinogenicity of CMME results from that chemical, from the contaminating BCME, or from their combination. Technical CMME, contaminated with BCME, is considered a potential human cancer hazard.

OSHA issued an emergency temporary standard covering both chemicals in 1973 and a final standard in 1974. This limits exposure to the lowest feasible level through prohibition of operation in open vessels and by the requirement for exhaust fans, control of contamination, protective clothing and devices, and warning signs and labels. EPA proposed general water quality criteria for chloroalkyl ethers in October 1979. These would include both BCME and CMME. The possible need for air emission regulations is being assessed.

Mustard Gas

Mustard gas was manufactured in the past for purposes of chemical warfare. It is not in the TSCA inventory of commercial chemicals, nor is any other information available indicating that there is any manufacture, use or exposure in the United States at the present time.

The best evidence for carcinogenicity of mustard gas comes from a study of Japanese workers in a factory manufacturing this substance from 1929-45 where an increased incidence of cancer of the respiratory tract was observed. In experimental studies, it has increased the number of lung tumors in exposed mice.

Since there is no reported production or use, there are presently no specific regulations in effect for mustard gas. Should someone choose to make it, such manufacture would fall under OSHA's "general duty clause" requiring that places of employment be "free from recognized hazards that are likely to cause death or serious physical harm to his employees." In addition, under the Toxic Substances Control Act, it would be considered a new chemical and would have to meet the requirements of this Act.

2-Naphthylamine

Substantial amounts of 2-naphthylamine were made at one time for use in the dyestuffs industry. Since its carcinogenicity has become known, use has declined and has been discontinued in a number of countries. One American company reported 2-naphthylamine for TSCA inventory, but without indicating whether it manufactured or imported the chemical and without indicating the quantities involved. An estimated 1000 workers may be exposed, including some in research laboratories. 2-Napththylamine may be formed in small quantities from pyrolysis of nitrogen-containing organic matter. It is also a contaminant of 1-naphthylamine which has also been used in the dye industry.

Occupational exposure to 2-naphthylamine has been shown to cause bladder cancer in workers. It also induces bladder cancer in monkeys, dogs, and hamsters, and liver tumors in mice.

OSHA regulated worker exposure to 2-naphthylamine to the lowest feasible level through an emergency temporary standard in 1973 and a final standard in 1974. Operations in open vessels were prohibited and use of exhaust fans, contaminant controls, protective clothing and devices, and warning signs and labels are required.

Soots, Tars, and Oils

Each of these materials is a complex mixture derived from a number of different sources and composed of many ingredients. The nature of these ingredients depends on the source or method of production of the material and on the extent to which the material is purified. "Oils" is a particularly broad term including many substances for which there is no evidence for carcinogenicity, in addition to the crude mineral oil lubricants and shale oil that have been shown to be carcinogenic. Thus, although materials known by each of these labels have been demonstrated to be carcinogenic, not all materials so named or all substances derived from these materials are carcinogenic. In each case, the carcinogenic chemicals within the mixtures constitute a small proportion of the total. They may be essentially all removed, for example, from carbon black which is derived from soot or from medicinal grade mineral oils purified from crude mineral oil. These facts should be kept in mind when considering levels of production or exposure cited in this report. On the other hand, combustion occurs widely in both industrial and non-industrial settings resulting in unintentional production of soot and volatile materials. Exposure figures from these sources are not included here, but it can be assumed that the entire population is exposed at some level. It is also apparent that total elimination of human exposure to carcinogenic products of combustion is not possible.

In 1975, domestic production of coal tar was reported to be almost 35 million pounds, while two million pounds of coal tar neutral oil were produced. One hundred twenty-one thousand workers were estimated to be exposed to tars. Production of creosote in the United States approached one billion pounds in 1976. Production figures relate to pesticides only.

Occupational exposure to the soot, tar, pitch and fumes from coal has caused cancer in humans at several sites. These materials contain carcinogenic chemicals classified as polycyclic aromatic hydrocarbons. Other chemical ingredients may also contribute to the carcinogenicity of these substances. Exposure to crude mineral oils and shale oil have also led to the development of cancer in humans. Animal experiments have demonstrated the carcinogenicity of coal-tars, soot, creosote oils, shale oils, and cutting oils. A number of polycyclic aromatic hydrocarbons extracted from some of these materials are carcinogenic in experimental animals.

OSHA established a permissable exposure limit for coal tar pitch volatiles of 0.2 mg per cubic meter as an eight-hour time-weighted average. EPA issued a rebuttal presumption against the registration of pesticides containing coal tar, coal tar neutral oil and creosote. Public responses to this are under review, and a determination is expected in 1980. FDA regulates the use of carbon black in food, drugs and cosmetics, use of petrolatum and mineral oil in food, and the use of coal tar in drugs. The use of carbon black as a coloring agent in food, drugs, and cosmetics has been prohibited since 1976. Carbon black may still be used in food packaging materials, but only if it is free of measurable polycyclic aromatic hydrocarbons and its migration into food is "nil." Petrolatum and mineral oil may be used for coating fruits and vegetables and as a release agent for bakery products only if they do not contain polycyclic aromatic hydrocarbons. The use of coal tar for treatment of skin disorders is under review.

Vinyl Chloride

The principal use of vinyl chloride is in the production of plastics. It is also used in the synthesis of other chemicals and formerly was used as an aerosol propellant. Current annual domestic production is 6.9 billion pounds. More than 3.5 million workers are potentially exposed. In addition, 4.6 million people live within five miles of industrial sites at which environmental emissions could occur. Very low levels of exposure may occur from leaching into food or medical products from unreacted vinyl chloride remaining in polyvinyl chloride used for containers.

The first evidence of carcinogenicity in humans came from the observation of a rare type of cancer, angiosarcoma of the liver, in workers exposed to vinyl chloride. This has been confirmed in more extensive epidemiologic investigation. There is also evidence that the chemical causes tumors of the brain, lung, blood system, and possibly other organs in humans. Angiosarcoma of the liver, as well as other tumors, have been induced in mice, rats, and hamsters.

The occupational standard of 500 ppm, in effect since 1952, was lowered to 50 ppm by OSHA's emergency temporary standard of April 1974. A permanent standard of 1 ppm was proposed in May 1974, and adopted in October 1974. Medical surveillance, training for workers, use of protective clothing and respirators, warning signs and product labeling, a written compliance plan and periodic monitoring are required by OSHA. CPSC, FDA and EPA each banned the use of vinyl chloride as an aerosol propellant, eliminating exposure from the source of between one and five million people annually. EPA proposed water quality criteria in March 1979, and set the national emission standards for hazardous air pollutants, vinyl chloride, in 1976. FDA has also eliminated its use in drug products and has altered food manufacturers to the need to monitor packaging materials for vinyl chloride.

3. Industrial Processes

The industrial processes discussed here include: cadmium and cadmium compounds, chromium and chromium compounds, hematite and nickel and nickel compounds. All but cadmium and cadmium compounds and hematite were considered by the 1979 IARC Ad Hoc Working Group to be carcinogenic for humans. Cadmium and cadmium compounds were considered as probably carcinogenic for humans with "higher degrees of evidence." Hematite could not be classified as to its carcinogenicity for humans. However, underground hematite mining was considered to be carcinogenic for humans. Although each process is identified by a particular chemical of interest in the process, that does not mean that the given chemical itself is carcinogenic in each of these processes. The actual chemical, or mixture of chemicals, responsible for human cancer in each case is unknown. In some processes, nickel or chromium for example, some of the named chemicals have been shown to be carcinogenic to experimental animals, but which specific nickel and chromium compounds in the process contributes to human risk of cancer is not known. While hematite itself has not been shown to be carcinogenic in experimental animals, underground hematite miners have an excess risk of lung cancer.

Cadmium and Cadmium Compounds

These chemicals are widely used commercially in electroplating, alloys, soldering, plastic stabilizers, batteries, fungicides, and in phosphors and pigments for television tubes, inks, artists' colors, glass, ceramics, textiles and paper. Cadmium is also present in zinc ores and may be released into the environment by smelters. Cadmum is found naturally at low levels in food and drinking water, but these levels may be increased by environmental contamination. Thus, the entire population is exposed to small amounts of cadmium in the diet (0.05-0.14 ppm) and drinking water and some unknown portion of the population through contact with cadmium-containing products. About 359,000 people have occupational exposure to cadmium and its compounds. Domestic production of cadmium and eight important compounds is 25 million pounds, while three million pounds are imported.

Several studies of occupational exposure to cadmium have suggested an increased risk of cancer of the prostate and possibly the respiratory tract. An IARC working group that evaluated the data in 1975 concluded that "occupational exposure to cadmium in some form. . . increases the risk of prostate cancer in man." The 1979 IARC Ad Hoc Working Group was more equivocal. They categorized the human evidence as "limited," a category between "sufficient" and "inadequate." "Limited evidence of carcinogenicity indicates a possible carcinogenic effect in humans, although the data are not sufficient to demonstrate a causal association." Several cadmium compounds have induced tumors at the injection site of rats. The significance of this as an indicator of carcinogenicity, in the absence of other types of evidence, is a subject of debate. Testicular tumors also have been induced in mice and rats, possibly because of effects on the pituitary gland. Thus, there are differences of opinion among scientists about the potential carcinogenicity of cadmium or its compounds for humans.

The maximum drinking water contamination by cadmium permitted by EPA is 0.01 mg per liter. This is under review. General water quality criteria were proposed in March 1979. EPA has issued a rebuttable presumption against registration of cadmium-containing pesticides, but final action has not been taken. OSHA standards set permissible exposure limits for cadmium fumes at 0.1 mg per cubic meter of air and for cadmium dust at 0.2 mg per cubic meter. Each of these is for an eight-hour time weighted average. FDA limits leaching from pottery and enamel to 0.5 mg.

Chromium and Chromium Compounds

Chromium in the form of chromium compounds is widely distributed in air, water, soil and food. It is an essential ingredient in our diet in trace amounts. The aggregate annual domestic production of chromium and ten important chromium compounds is over 900 million pounds. About 114 million pounds are imported. Chromium and its compounds are used in metal alloys such as stainless steel, as protective coatings on metal, on magnetic tapes, and as pigments for paints, cement, paper, rubber, composition floor covering, and other materials. The entire population is thus exposed to some of these substances, but levels of exposure obviously vary for different compounds. OSHA estimates that 4,400,000 people are exposed through their occupations.

Workers in the chromate-producing industry have an increased incidence of lung cancer. Chromium platers and chromium-alloy workers may also have an increased risk of lung cancer, bu the evidence is less conclusive. Animal experiments involving exposure to calcium chromate by several routes, including inhalation and intratracheal implantation, have demonstrated carcinogenicity. Several other chromate compounds, namely, strontium chromate, zinc chromate, and chromic chromate, produced local tumors at the site of injection. The animal data for other chromium compounds is inadequate. Thus it is clear that at least some chromium compounds are carcinogenic in animals and that chromium industry workers may have an increased risk of cancer. The particular compounds responsible for this risk are not clear.

OSHA's permissible exposure limits are 0.5 mg per cubic meter of air for soluble chromium compounds and 1 mg for chromium metal and insoluble compounds. The maximum level permitted in drinking water by EPA is 0.05 mg per liter. Water quality criteria were proposed in October 1979. Effluents are controlled through issuance of permits, including provisions of the applicable effluent guidelines at minimum.

Hematite

Hematite, a term for iron oxide or the ore from which it comes, is a major source of iron. Combined production and imports into this country, according to EPA figures, approach 2 billion pounds, making it one of the highest volume substances on this list. Present evidence, however, does not adequately demonstrate that hematite itself is carcinogenic to humans. Hematite miners working underground have been found to have an increased incidence of lung cancer. These miners also are exposed to silica dust, and exposure to the radioactive gas radon was found to occur in one hematite mine in England. Studies of surface miners and workers exposed to iron oxide from other occupations have not shown convincing evidence of carcinogenicity. Experiments exposing animals to ferric oxide have either been negative or inconclusive.

Regulation of conditions in mines falls under the Mine Safety and Health Administration. The "general duty clause" of OSHA would apply to general worker exposure.

Nickel and Nickel Compounds

Annual domestic production of nickel and 14 nickel compounds in 169 million pounds; 425 million pounds are imported. Major uses are in production of metal alloys, metal plating, batteries, spark plugs, ceramic glazes, pigments for paint, and catalysts used in the manufacture of organic chemicals, petroleum refining and hardening of edible oils. Estimates of workers exposed vary. Based on the National Occupational Hazard Survey data, OSHA estimates the number of workers exposed at 709,000. The entire population is exposed to low levels of nickel (300-600 micrograms per day) in food and water. Nickel compounds may become air pollutants from the combustion of coal, diesel oil and fuel oil.

Epidemiologic investigations of workers in several nickel refineries have shown an increase in cancer of the nasal cavity and of the lung. Other occupational groups exposed to nickel have not been adequately studied. Nickel subsulfide induced lung cancer in rats exposed by inhalation and produced injection site tumors in both rats and mice. Suggestive evidence of carcinogenicity by intravenous and inhalation routes of exposure in rats exists for nickel carbonyl, a possible air pollutant resulting from the burning of nickel-containing fuels. Other nickel compounds have not been adequately studied in animals by routes pertinent to human exposure. For example, nickel powder and several nickel compounds have produced tumors at the site of the injection; the significance of this route of exposure is unresolved. In summary, while nickel refinery workers have an increased risk of developing cancer, it is not known which one of the nickel compounds, or mixtures thereof, is carcinogenic.

The workplace exposure limit of 1 ppm for nickel carbonyl, in effect since 1952, was lowered by OSHA in 1971 to 0.001 ppm or 0.007 mg per cubic meter. For other forms of nickel, the permissible exposure limit is 1 mg per cubic meter as nickel and as metal soluble compounds. EPA established effluent guidelines for some industries and controls effluents by issuing permits. Water quality criteria were proposed in July 1979. The possible need for air quality regulation is being assessed.

4. Industrial By-Products

These are unintentional products of industrial activity. They are formed during the manufacture of some product of commercial use. Since they are not produced for their commercial value, they are often poorly characterized, and good production figures may be lacking. The only industrial by-products considered in this report are the isopropyl oils. These oils are formed during the manufacture of isopropyl alcohol. The 1979 IARC Ad Hoc Working Group stated that the isopropyl oils could not be classified as to its carcinogenicity for humans. Manufacture isopropyl of alcohol by the strong acid process was classified as carcinogenic for humans.

Isopropyl Oils

There are several industrial approaches for the manufacture of isopropyl alcohol. One involves the reaction of sulfuric acid with propylene gas. There are two processes using this approach: one uses stong sulfuric acid at moderate temperature; the other uses somewhat weaker acid at a higher temperature. In addition to producing isopropyl alcohol, these two processes leave a residue composed of a mixture of many organic chemicals. This residue is called isopropyl oils. Evidence of human carcinogenicity is limited to the strong acid process for the manufacture of isopropyl alcohol and the isopropyl oils associated with it. No figures are available on the quantity of isopropyl oils produced during the manufacture of isopropyl alcohol or worker exposure to them. Production figures for isopropyl alcohol are cited in this report; however, they are a poor indicator of worker exposure to the manufacture of isopropyl alcohol by the strong acid process, since newer processes have been replacing this one.

As increased incidence of cancer of the nasal sinuses and respiratory tract was found among workers in two factories that had produced isopropyl alcohol by the strong acid process. No studies of plants using other processes are available. Several experimental investigations of isopropyl oils produced by the strong acid process have suggested carcinogenicity but have not been definitive.

There are not any specific regulations regarding isopropyl oils. They would fall under OSHA's "general duty clause," however.

5. Pharmaceuticals

The heaviest exposure to pharmaceutical chemicals occurs among those patients being treated. Although of major concern to the Food and Drug Administration, these chemicals assume lower priorities for OSHA and EPA. In regulating pharmaceuticals, FDA is required to consider their benefits to health as well as their risks. Pharmaceutical chemicals are specifically excluded from the TSCA inventory of chemicals in commerce, though they may be listed in error or if they have other commercial usages. OSHA does not have specific regulations for workplace exposure to any of the pharmaceuticals listed here. Each, however, is covered by the requirement that places of employment be "free from recognized hazards that are likely to cause death or serious harm" to employees. All of the following pharmaceuticals as well as all human prescription drugs in oral dosage form (other than those specifically exempted) are subject to CPSC's Child Resistant Packaging Standards. These standards require packaging which will preclude entry by at best 80% of children under 5 years of age.

This category includes: N,N-bis(2-chloroethyl)-2-naphthylamine, chloramphenicol, cyclophosphamide, diethylstilbestrol (DES), melphalan, oxymetholone, phenacetin, and phenytoin. The 1979 IARC Ad Hoc Working Group classified diethylstilbestrol, melphalan, and N,N-bis(2-chloroethyl)-2-naphthylamine as carcinogenic for humans. Cyclophosphamide was classified by this Working Group as probably carcinogenic for humans with "higher degrees of evidence," while oxymetholone and phenacetin were classified as probably carcinogenic for humans with "lower degrees of evidence." This Working Group could not classify chloramphenicol and phenytoin with respect to their carcinogenicity for humans due to the inadequacy of the avalable data.

N,N-Bis(2-Chloroethyl)-2-Naphthylamine

This pharmaceutical chemical, also known as chlornaphazine, has been used in some countries to treat leukemia and related cancers. There is evidence that it has caused bladder cancer in humans, and it has caused tumors in experimental animals. It has not been produced or used commercially in the United States.

Chloramphenicol

This antibiotic is used and approved for treatment of bacterial and rickettsial infections in humans and non-food producing animals. Between 120,000 and 150,000 patients are treated each year. Although it is not approved for use in food-producing animals, some illegal use in animals results in some human exposure. FDA does not have a sufficiently sensitive monitoring technique to detect these possible residues for chloramphenicol in food.

The most important toxic effect of chloramphenicol therapy is damage to the bone marrow with reduction of blood cells. Estimates of the frequency of this effect range from one case in 24,500 to one case in 227,000 patients receiving chloramphenicol. Leukemia may develop in some patients who survive the bone marrow damage.

Chloramphenicol is regulated as a prescription pharmaceutical. Systemic dosage forms carry labels warning about carcinogenicity and advising that unnecessary exposure be avoided.

Cyclophosphamide

Cyclophosphamide is a prescription pharamceutical approved for treatment of cancer. It also has some investigational use for suppresing immunological activity in non-malignant diseases such as rheumatoid arthritis and the kidney diseases glomerulonephritis and the nephrotic syndrom. FDA estimates that 200,000-300,000 patients may be treated with it each year. Their daily dose is 15 mg per kilogram of body weight.

There has been a number of reported cancer cases arising some time after treatment of non-malignant disease and second cancers arising after treatment of an earlier cancer with cyclophosphamide. These were mostly leukemias and bladder cancer, but other types have been reported as well. An epidemiologic study of patients treated for cancer of the ovary with a number of different alkylating drugs, including cyclophosphamide, showed a subsequent increase in leukemias. These results suggest that this pharmaceutical can cause cancer in humans, but neither IARC working group regarded the evidence as definitive. Several studies in rats and mice have found cyclophosphamide to be carcinogenic.

Information warning of the danger of inducing cancer with this pharmaceutical is required in each package. Some of the non-malignant diseases for which this chemical may be used are extremely serious or fatal.

Diethylstilbestrol (DES)

This is a synthestic pharmaceutical developed to have the function of natural estrogens, hormones which are produced by the ovary. It is more effective after oral administration than natural estrogens. About 500,000 patients are treated each year with this pharmaceutical chemical, the majority for cancer of the prostate and other cancers. Other uses include treatment for menopausal and post-menopausal symptoms and breast engorgement following delivery. Most of the rest of the population was exposed to low levels (less than 10 ppb in the diet) because of its use as a growth promoter in cattle and sheep. This use is being reevaluated. During the 1940's and 1950's, DES was prescribed extensively for the treatment of threatened miscarriage. This use declined following evidence that it was both ineffective and sometimes hazardous.

Several studies have found that a small proportion of the daughters of women exposed to relatively large doses of DES or other estrogens during pregnancy developed cancer of the vagina. This kind of cancer is ordinarily very rare. There is also evidence, though less conclusive, that prolonged treatment with DES can cause cancer of the uterus and breast. Experiments with several species, including monkeys, have shown that DES and other estrogens can cause cancer, especially in organs that are responsive to estrogens.

FDA's labeling requirements for DES include warnings to physicians and patients of the risk from treatment with estrogens. The labels specifically warn that DES should not be used during pregnancy. A regulation by FDA prohibiting the use of DES in food-producing animals has been challenged in court.

Melphalan

Melphalan is approved by FDA only for treatment of two types of cancer: multiple myeloma and cancer of the ovary. It also has some investgational use for other types of cancer. Between 30,000 and 50,000 patients may be treated each year.

There have been several case reports and two epidemiological studies showing that patients treated for one cancer with melphalan may develop another malignant tumor later. In most cases, the second cancer has been leukemia. several studies with rats and mice have demonstrated the carinogenicity of the drug.

Use is restricted to treatments approved by FDA.

Oxymetholone

Oxymetholone is a synthetic hormone having actions similar to those of the male hormone, testosterone. At one time, a major use was for treatment of anemias caused by deficient production of red blood cells. In 1972, however, FDA dropped its approval of this use since evidence supporting its effectiveness for this purpose was inadequate. Since then, the only approved use has been treatment of senile and post-menopausal osteoporosis, a condition in which bones become brittle. FDA's Bureau of Drugs estimates that 50-100,000 patients are treated each year with oxymetholone.

Several cases of liver tumors have been reported in patients treated for anemia for long periods with this and other androgenic pharmaceuticals (i.e., drugs having testosterone-like action). These pharmaceuticals may also cause severe damage to the liver, including the formation of blood cysts. Hemorrhage from these cysts can be a serious complication. There are no published studies of the possible carcinogenicity of oxymetholone in experimental animals. The evidence suggests that oxymetholone and other androgenic drugs may case liver tumors in humans, but neither of the IARC working groups that reviewed the data considered it to be conclusive.

As described above, FDA reduced the list of approved uses of oxymetholone in 1972. Since 1977, warnings of danger of liver damage and cancer have been required within the packages of this pharmaceutical.

Phenacetin

Phenacetin has been produced commercially in the United States for at least 50 years. It is generally mixed with other pharmaceutical agents and used in over-the-counter remedies for pain and fever. The widespread availability of these remedies indicates that a high proportion of the population may be exposed with doses ranging up to one gram per day. EPA figures indicate annual domestic production of 550,000 pounds, with 55,000 pounds being imported. The fact that some companies have reported phenacetin to the TSCA inventory of commercial chemicals suggests that phenacetin may have commercial uses other than as a pharmaceutical.

Several studies have reported that heavy, chronic use of pharmaceuticals containing phenacetin, by humans, may be associated with damage to the portion of the kidney where urine collects, and that cancer may develop in this region. Exposure was generally to mixtures of phenacetin with other pharmaceuticals. Although an eariler study in rats had been negative, an investigation published in 1979 reported an excess of urinary tract and nasal cancer in rats fed diets containig phenacetin. Liver tumors have also been induced in rats with N-hydroxyphenacetin. This chemical is though to be a possible metabolite of phenacetin. In 1979, the IARC Ad Hoc Working Group decided that there was "limited evidence" of carcinogenicity in humans and experimental animals.

After an advisory panel dtermined that phenacetin could not be considered "safe" for over-the-counter use, the FDA initiated administrative hearings to remove it from these products. This has been challenged by objections to the validity of the carcinogenicity data.

Phenytoin

Diphenylhydantoin, as this pharmaceutical is called in the United States, is one of the most important prescription pharmaceuticals for the control of epilepsy. Figures on the number of patients using it are not now available, but it is used by a major segment of the epileptic population.

Several case reports and epidemiological studies have found an increased incidence of malignant lymphomas in epileptics who were treated with this chemical. Some of them had also been treated with other pharmaceutical chemicals. One study reported a small increase in lymphomas in the children of epileptic mothers as well. One large epidemiological study of epileptics (over 9,000 cases) treated with phenytoin or other pharmaceutical chemicals failed, however, to find an excess of lymphomas. IARC working groups have noted the reported association between anti-convulsant therapy and lymphomas in humans, but the 1979 IARC Ad Hoc Working Group considered the evidence inadequate to allow a conclusion as to carcinogenicity for humans. Mice treated with phenytoin have developed an increase in lymphomas. Other species have not adequately tested.

The FDA has asked an advisory committee to assess the data and make a recommendation.

D. The Regulatory Council's Statement on Setting Priorities for Regulating Carcinogens and on Carcinogen Related Missions of NTP Participating Agencies

Each of the agencies participating in this effort have specific regulatory responsibilities with rspect to carcinogens assigned by law. These agencies coordinate their efforts in determining whether a chemical or industrial process may cause cancer, assessing the risk of cancer to humans, and setting priorities for regulating carcinogens. This coordination has been developed by the Interagency Regulaory Liaison Group (IRLG).

In October 1979, the Regulatory Council published in the Federal Register its "Statement on Regulation of Chemical Carcinogens, Policy and Request for Public Comment." This section of the report, taken from the Federal Register contains its statement on setting priorities for regulating carcinogens and brief summary statements for the Federal agencies paticipating in the National Toxicology Program.

SETTING PRIORITIES FOR REGULATING CARCINOGENS

"A substantial number of cancer-causing chemicals has already been identified. As other chemicals are tested, some of them also are likely to be found capable of producing cancer. In deciding which ones to regulate first, Federal agencies will generally assign higher priorities to substances for which:

- There is substantial evidence that the substance is likely to present a risk of human cancer. Epidemiological studies and/or animal testing are sources of such evidence.
- There is reason to believe that the level of human exposure and/or risk is high. Either quantitative or nonquantitative risk assessments may provide a basis for such belief.
- The exposed population is large or is of special concern, such as children.
- Regulatory action could significantly reduce the extent of intensity or human exposure.
- Regulatory action could reduce not only cancer risk but also other human health and environmental hazards.
- A substance is, or could be, available that would pose a lower risk of cancer or other serious human health problems, or available evidence otherwise suggests that the social and economic costs of regulation would be small.

The relative importance of these priority-setting criteria will necessarily vary from case to case, and in establishing their final priorities the agencies also consider:

- The requirements of applicable laws or court orders which may limit their flexibility to establish their own priorities.
- Their responsibilities for dealing with other health and environmental hazards.
- The regulatory actions being taken or planned by other agencies.

Although the agencies will continue to coordinate their regulatory actions, each agency will establish its own regulatory priorities. Specific substances usually are not equally important from the standpoint of every agency's statutory mission. As an example, one substance may provide a serious risk in consumer products, but present little risk to workers. The most effective public health protection would occur if the agency concerned with protecting workers gives the former a higher priority and the agency concerned with protecting consumers gives the latter a higher priority.

In general, the regulatory programs will provide the most public health protection if each agency dealing with a specific area of exposure places the highest priority on the substance which provides the greatest health risk in its area of concern. Otherwise, agencies might be regulating substances which are of relatively little importance in their area of concern, creating unnecessary regulations and costs, with little public health benefit, and putting off actions which would provide much more benefit. For these reasons, its is neither necessary nor desirable that all agencies assign the same priority to each substance."

The Carcinogen Related Missions of
NTP Participating Agencies

Consumer Product Safety Commission (CPSC)

"The purpose of the Consumer Product Safety Commission is to protect the public against unreasonable health and injury risks from consumer products; to assist consumers to evaluate the comparative safety of consumer products; to develop uniform safety standards for consumer products and minimize conflicting State and local regulations; and to promote research and investigation into the causes and prevention to product-related deaths, illnesses, and injuries.

The Commission assesses the health risks associated with the use of potential carcinogens in consumer products, and has the authority to restrict or prohibit uses considered to provide an unreasonable risk. It also sponsors some research on carcinogenic substances.

The statutes defining CPSC's responsibilities for regulating carcinogens and other toxic substances include The Federal Hazardous Substances Act (1966), The Consumer Product Safety Act (1972), and the Poison Prevention Packaging Act (1970)."

Environmental Protection Agency (EPA)

"The purpose of the Environmental Protection Agency is to protect and enhance our environment by controlling pollution in the areas of air, noise, radiation, and toxic substances.

EPA regulates potential carcinogens under several statutes, controlling their release into the air and water, their disposal as solid or liquid wastes on land and in the ocean, their occurrence in drinking water supplies, and their use in pesticides. It also is responsible for developing national strategies for controlling the general production and use of such substances and with coordinating these activities with other agencies. EPA also conducts and sponsors research on how chemicals are transported through and modified by the environment and on the carcinogenic potential of selected substances.

The statutes defining responsibilities for regulating carcinogens and other toxic substances include The Toxic Substances Control Act (1976), The Clean Air Act (1970, amended 1977), The Clean Water Act (as amended in 1972 and 1977), The Safe Drinking Water Act

(1974, amended 1977), The Federal Insecticide, Fungicide, and Rodenticide Act (1947, amended 1972, 1975, 1978), The Act of July 22, 1954 (codified as section 346(a) of the Food, Drug, and Cosmetic Act) (1954, amended 1972), and The Resource Conservation and Recovery Act (1976)."

Food and Drug Administration (FDA)
(U.S. Department of Health, Education, and Welfare)

"The purpose of the Food and Drug Administration is to protect the health of the Nation against impure and unsafe foods, drugs, cosmetics, and other potential hazards.

FDA regulates the composition, quality, and safety of foods, food additives, food contaminants, colors, human and animal drugs, medical devices, and cosmetics. It must, by law, prohibit the use of any food additive found to be a carcinogen. It also conducts and sponsors research on the carcinogenicity of food contaminants, cosmetics, and other substances, and on the development of better methods for detecting the carcinogenic potential of regulated substances. FDA also develops methods to detect the presence of these substances in consumer products and monitors them to ensure their compliance with regulations.

The statutes defining FDA's responsibilities for regulating carcinogens and other toxic substances include The Food, Drug, and Cosmetic Act (1938) with its amendments pertaining to food additives (1958), color additives (1960), new drugs (1962), and new animal drugs (1968); The Fair Packaging and Labeling Act (1976); and The Public Service Act (1944)."

National Cancer Institute (NCI)
(National Institutes of Health, U.S.
Department of Health, Education and Welfare)

"The purpose of the National Cancer Institute is to expand scientific knowledge on the causes, prevention, diagnosis, and treatment of cancer in order to eliminate this disease as a national health problem.

NCI conducts and sponsors research on the origin, causes, and spread of cancer and on methods of diagnosing, preventing, and treating cancer. It conducts animal tests and epidemiological studies to identify carcinogens and research directed at developing improved testing methods for identifying carcinogens. It also, through its cancer control element, applies research findings to prevent, control, and treat human cancer and to rehabilitate cancer victims."

National Institute of Environmental Health Sciences (NIEHS)

(National Institutes of Health, US Department
of Health, Education and Welfare)

"The purpose of the National Institute of Environmental Health Sciences is to provide information on the impact of environmental factors on human health in order to aid those agencies charged with devising and instituting control or therapeutic measures.

NIEHS supports and conducts basic research focused upon the interaction between man and potentially toxic or harmful agents in his environment. This research is concentrated upon recognizing, identifying, and investigating the environmental factors that may have deleterious effects on population groups, on quantifying those efforts, and on understanding the mechanisms of action of toxic agents on biological systems."

National Institute of Occupational Safety and Health (NIOSH)

(Center for Disease Control, Public Health Service, U.S.
Department of Health, Education and Welfare)

"The purpose of the National Institute of Occupational Safety and Health is to conduct research on and development standards for occupational safety and health to ensure safe and healthful working conditions for all working people.

NIOSH conducts epidemiological laboratory testing, exposure and source characterization studies on potential carcinogens found in the workplace. It also develops methods for monitoring the presence of carcinogens and for testing worker protection equipment and makes recommendations to OSHA regarding standards that should be applied to control workplace exposure and protect workers' health."

Occupational Safety and Health Administration (OSHA)

(U.S. Department of Labor)

"The purpose of the Occupational Safety and Health Administration is to ensure, so far as possible, safe and healthful working conditions for every working man and woman in the Nation.

OSHA assesses the health risks to workers associated with the use of carcinogenic substances in the workplace, and regulates the release of and concentration of carcinogenic substances that can occur in the workplace. It also monitors job related illnesses and informs workers of the potential hazards associated with specific substances found in the workplace.

The statute defining OSHA's responsibilities for regulating carcinogen and other toxic substances is the Occupational Safety and Health Act (1970)."

E. Summary of Agency Submissions

The tables contained in this section provides a collated overview of the participating agencies' responses to the questions posed in the Community Health Centers Act, Amendments, PL 95-622, November 9, 1978. It should be noted that in many cases the full agency submission, Appendix I of this report, may contain more information about a specific chemical than could be included in a selectively derived summary table format. In other cases the summary table may contain additions that were subsequently submitted by the agencies. It is suggested that for those interested in a specific chemical they also review all the individual agency submissions concerning this specific chemical.

The Act also requires that:

> "..., the extent to which, on the basis of available medical, scientific, or other data, such standard, and the implementation of such standard by the agency, decreases the risk to public health from exposure to the substance;..."

Since there is no consensus today as to what mathematical model one should use in making these estimates; in fact, some even question the meaningfulness of such an approach, per se; we have included the regulatory history of tracking the reduction of exposure as the best available answer to this question at the present time.

			Exposure					Regulation		
						Degree				
Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Types of Population Exposed	NOHS* and Other Exposure Estimates	Route	Level of Exposure	Frequency of Exposure	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
Aflatoxins 1162-65-8 7220-81-7 1165-39-5 7241-98-7	Domestic None (EPA, FDA) Imports None (FDA)	Contaminant of corn, corn products, cottonseed, peanuts, animal tissue, milk, milk products, eggs (FDA)		Entire population through consumption of foods listed (possible) (FDA)	Oral (3) (OSHA)	0.148-0.490 ug/day (estimates) (FDA)	Daily possible; Environmental persistence; years (FDA)	Aflatoxins were found to be unavoidable contaminants of foods. Enforcement action levels of 20 ppb for all products are in effect. (FDA) Regulated by the general duty clause (OSHA) As naturally occurring contaminants of food, these substances are of secondary regulatory interest to EPA at this time. There are no data to indicate that they are present in effluents, emissions, or plant wastes. (EPA)	Holds human exposure to lowest practicable level (FDA)	CFR 21 7412.01 7412.05 7420.01 (FDA) PL 91-596 Section 5 (a) (EPA, OSHA)
4-Amino-biphenyl 92-67-1	No production reported on TSCA Inventory (EPA)		Diphenylamine workers, research workers (OSHA)	1,000 (number of workers exposed) (OSHA)	Inhalation percutaneous absorption (OSHA)			EPA has no data to document a controllable environmental hazard at production facilities involving this chemical (EPA) PEL - Lowest feasible level Protective clothing, respirator, hygiene, training and medical surveillance requirements for workers; exhaust fan requirements; open vessel operations prohibited; contamination control requirements; sign requirements for regulated areas; labelling requirements for containers. (OSHA)	May 18, 1973 Emergency temporary standard Protective clothing and hygiene requirements for workers, Open vessel operations restricted, Engineering requirements February 11, 1974 Final standard Current regulations effective (OSHA)	29 CFR 1910.1011 (OSHA)

* NOHS - National Occupational Health Survey.

			Exposure					Regulation		
						Degree				
Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Level of Exposure	Frequency of Exposure	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
Arsenic 7440-38-2	Domestic: 69,717,000 (lbs) (EPA) Imports: 19,877,500 (lbs) (EPA) Production figures EPA address arsenic, arsenic pentoxide, arsenic trioxide, sodium arsenate, potassium arsenate, sodium arsenite (EPA) Some site limitations; 41 producers and importers in 10 SFR s (EPA)			Estimated total environmental emissions-- 9,268 tons 1 year (Office of Air Quality Planning and Standards) (EPA)				Interim primary drinking water regulation (EPA)	Establishes maximum contaminant level of 0.05 mg/l. Does not address carcinogenicity. Under review, and may be revised at a later date (EPA)	40 CFR 141.11 (EPA)
								Effluent guidelines for certain industrial categories (EPA)	Establishes control over arsenic in certain effluents through permits issued under the NPDES. Carcinogenicity is not a factor in developing effluent guidelines. (EPA)	40 CFR 415, 421, 429 and 430 (portions) (EPA)
								Water quality criteria (EPA)	Proposed 3/79; subject to revision in final (EPA)	44 FR 15926 et seq.
			Arsenic workers, brass makers, bronze makers, ceramic makers, copper makers, dye makers, hide preservers, herbicide and insecticide makers, lead smelters, paint makers, printing ink workers, silver refiners (OSHA)	Number of workers exposed— 545,000 (OSHA)	Inhalation of dusts and fumes ingestion of dusts and fumes (OSHA)			Protective clothing, respirators, hygiene, training and medical surveillance requirements for workers; monitoring requirements; housekeeping requirements; sign requirements for regulated areas; labelling requirements for containers. (OSHA) PEL -- 0.5 mg/m^3 8 hr TWA as arsenic (organic) 10 ug/m 8 hr TWA (inorganic). No skin or eye contact with arsenic chloride (OSHA)	1952 Walsh-Healy 0.5 mg/m^3 maximum allowable concentration August 27, 1971 OSHA takeover standard 0.5 mg/m^3, 8 hr As (arsenic and compounds) 1 mg/m^3, 8 hr TWA (calcium arsenate) 0.15 mg/m^3, 8 hr TWA (lead arsenate) June 30, 1978 Final standard current limit effective (OSHA)	29 CFR 1910.1018 (OSHA)
		Naturally occurring especially in ocean fish and crustaceans (FDA)		Entire population, especially seafood eaters (FDA)	Oral (FDA)	0.02 mg/day	Daily Environmental persistence years (FDA)	FDA Bureau of Foods; Food, Drug, and Cosmetic Act No specific action taken to decrease naturally occurring levels of arsenic (FDA)		

			Exposure					Regulation		
						Degree				
Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Level of Exposure	Frequency of Exposure	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
Arsenic (continued)		Present in drugs used as animal feed additives and subsequently becomes a residue of meats consumed (FDA)		Entire population (FDA)	Oral (FDA)	Low (FDA)	Daily Environmental persistence: years (FDA)	FDA Bureau of Foods and Bureau of Veterinary Medicine; Food, Drug, Cosmetic Act None of the regulated arsenic compounds are those that have been associated with occupational cancer. No data on their carcinogenic properties have been developed. (FDA)	Limits exposure from residues in meats obtained from treated animals. Seems quite effective for poultry; less so for swine. In terms of residual arsenic in treated animals, there is no data to indicate that dietary arsenic is carcinogenic. (FDA)	Both organic and inorganic arsenics are regulated under CFR 21 558.60 558.62, 558.120, 558.530, 180.334, 180.335 (FDA)
Arsenic pentoxide 1303-28-2	Aggregated under arsenic (EPA)			NOHS: 1,744 workers potentially exposed				Hazardous spill regulation designating harmful quantity, requiring reporting of spills and imposing penalties	Regulation promulgated 10/79. Goal is to encourage greater care in handling and shipment to prevent releases. Does not address carcinogenicity.	40 CFR 117
								RPAR issued regarding 11 inorganic arsenical pesticides (EPA)	Rebuttal under review. Notice of proposed determination expected 6/80. (EPA)	42 FR 202, p 48267 et seq (EPA)
								See regulations under arsenic (OSHA)		29 CFR 1910.1018 (OSHA)

Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Exposure					Regulation		
			Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Degree				
						Level of Exposure	Frequency of Exposure	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
Arsenic Trioxide 1327-53-3	Domestic: Aggregated under arsenic (EPA) Imports: Almost totally imported from Europe (CPSC)	Possible use in glass and ceramics (CPSC) Arsenic trioxide is the source material for 97% of arsenic products (088) (EPA)	Human exposure to be determined (CPSC)	NOHS: 10,762 workers potentially exposed	Ingestion (diet) (EPA, FDA)	0.10-0.16 ppm (adult) 0.100-0.180 ppm (toddlers) trace (infants) (EPA, FDA)	Based on 2 wks, prepared samples; not translated to mg/kg body weight (EPA, FDA)	Economic research studies being conducted by CPSC. (CPSC)		
								Hazardous spill regulation designating harmful quantity, requiring reporting of spills and imposing penalties. (EPA)	Regulation promulgated 10/79. Goal is to encourage greater care in handling and shipment to prevent releases. Does not address carcinogenicity. (EPA)	40 CFR 117 (EPA)
								Ban on use of formulations containing more than 1.5% in households or grazing areas (EPA)	Some reduction in use (EPA)	(Written notice to registrants 8/68 Not published in FR by USDA. Current procedures would require such publication.) (EPA)
								Registration of products for three uses voluntarily cancelled by producers. (EPA)	Minimal reduction in exposure potential, as these uses accounted for only a small amount of production. (EPA)	42 FR 177, p. 4594 (EPA)
								RPAR issued regarding 11 inorganic arsenical pesticides (EPA)	Rebuttal data under review. Notice of proposed determination expected 6/80. (EPA)	42 FR 202, p. 4626 et seq. (EPA)
								See regulations under arsenic (OSHA)		29 CFR 1910.1018 (OSHA)
Potassium arsenate 7784-41-0	Aggregated under arsenic (EPA)							Hazardous spill regulation designating harmful quantity, requiring reporting of spills and imposing penalties. (EPA)	Regulation promulgated October 1979. Goal is to encourage greater care in handling and shipment to prevent releases. Does not address carcinogenicity. (EPA)	40 CFR 117 (EPA)
								See regulations under arsenic (OSHA)		29 CFR 1910.1018 (OSHA)

			Exposure					Regulation		
						Degree				
Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Level of Exposure	Frequency of Exposure	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
Sodium arsenate **7631-89-2**	**Aggregated under arsenic (EPA)**							**Hazardous spill regulation designating harmful quantity, requiring reporting of spills, and imposing penalties. (EPA)**	**Regulation promulgated October 1979. Goal is to encourage greater care in handling and shipment to prevent releases. Does not address carcinogenicity. (EPA)**	**40 CFR 117 (EPA)**
								RPAR issued regarding 11 inorganic arsenical pesticides (EPA)	**Rebuttal data under review. Notice of proposed determination expected, 6/80. (EPA)**	**43 FR 202, p. 48267 et seq. (EPA)**
								See regulations under arsenic (OSHA)		**29 CFR 1910.1018 (OSHA)**
Sodium arsenite **7784-46-5**	**Aggregated under arsenic (EPA)**							**Hazardous spill regulation designating harmful quantity, requiring reporting of spills and imposing penalties. (EPA)**	**Regulation promulgated 10/79. Goal is to encourage greater care in handling and shipment to prevent releases. Does not address carcinogenicity. (EPA)**	**40 CFR 117 (EPA)**
								Ban on use of formulations containing more than 2.0% in households or grazing areas. (EPA)	**Some reduction in use (EPA)**	**(Written notice to registrants 8/68. Not published in FR by USDA. Current procedures would require such publication.) (EPA)**
								Registration of products for two uses voluntarily cancelled by producers (EPA)	**Some reduction in use (EPA)**	**42 FR 48, p. 13579 (EPA)**
								RPAR issued regarding 11 inorganic arsenical pesticides (EPA)	**Rebuttal data under review. Notice of proposed determination expected, 6/80. (EPA)**	**43 FR 202, p. 48267, et seq (EPA)**
								See regulations under arsenic (EPA)		**29 CFR 1910.1018 (EPA)**

			Exposure					Regulation		
						Degree				
Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Level of Exposure	Frequency of Exposure	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
Asbestos Crocidolite Chrysotile Amosite Actinolite Tremolite Anthophyllite 1332-21-4 12001-28-4 12001-29-5 12172-73-5 13678-00-8 14567-73-8 17068-78-9	Domestic: 1976 consumption 1,452, 000 lbs. (Bureau of Mines) 142 plant sites in 7 SFR's are subject to NESHAP's for asbestos (EPA) Units of individual products containing asbestos to be determined by CPSC research in FY 80 (CPSC) Imports: some importers reported for the TSCA Inventory (but not volumes) (EPA) Public Record only	In large number of consumer products submitted by CPSC including asbestos paper products, cloth and woven products, appliance wiring, asbestos cement products, viscous matrix products (CPSC)	Essentially entire population exposed to consumer products containing asbestos in some form. If not in a respirable form, then actual exposure may be lower. (CPSC)		Inhalation; ingestion			National emission standards for hazardous air pollutants addressing several industrial categories. (EPA)	Some reduction in airborne emissions, largely through engineering and practice control. The carcinogenic risk of airborne asbestos was a major factor in the promulgation of these regulations. The absence of economically feasible analytical methods precluded setting of numerical standards (EPA)	40 CFR 61.20-25 (EPA)
								Effluent guidelines for asbestos industry and for asbestos mining/milling. (EPA)	Does not directly address asbestos. Control of total suspended solids affords a degree of reduction through NPDES permits. Does not address carcinogenicity. (EPA)	40 CFR 427, 436 (portions) (EPA]
								Water quality criteria (EPA)	Proposed 10/79; subject to revision in final (EPA)	44 FR 191, p. 56628 et seq. (EPA)
								Voluntary abatement program for asbestos in schools. (EPA)	High interest in acting to encapsulate or replace asbestos-containing materials in school buildings. (EPA)	44 FR 17791 (EPA)
								Advance notice of proposed rulemaking. (EPA)	Seeks information on asbestos uses that would be good candidates for regulations issued in conjunction with CPSC. (EPA)	44 FR 202, p. 60056 et seq. (EPA)
								Ban in effect on personal use garments (1972) containing asbestos. (CPSC)	Essentially eliminated that type of exposure (CPSC)	1600 CFR 1500.17 (a) (7) (CPSC)
								Voluntary recall of hair dryers (CPSC)	(1979) 1.5 million units returned (CPSC)	
								Advance notice of proposed rulemaking describing proposed approach of seeking elimination of all non-essential uses of asbestos in consumer products from which asbestos fibers are released during use. (CPSC)		Citation: FR44: 202, 60056-60068 (1979) (CPSC)
								Ban (1978) on patching compounds and gas log emberizing materials containing respirable free asbestos (CPSC)	3 - 10 x 10^6 persons had been exposed to patching compounds; no subsequent exposures 0.5 - 1.5 x 10^6 persons exposed to emberizing materials; no additional exposures (CPSC)	1600 CFR 1304 (CPSC) 1600 CFR 1305

			Exposure					Regulation		
						Degree				
Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Level of Exposure	Frequency of Exposure	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
Asbestos (continued)		Contaminant of food or beverage from adhesives contact, repeat use polyester resins, phenolic resins and rubber articles FDA	*	Entire population (FDA)	Oral (FDA)	Assumed very low or "virtually nil" (FDA)	Daily (FDA)	FDA - Bureau of Foods; Food, Drug and Cosmetic Act Most permitted uses approved when asbestos was not known to be implicated as a carcinogen. At present there are no data available to estimate the levels of migration of asbestos into foods from the regulated uses. It is assumed that under good manufacturing practice, there will be "virtually nil" or "deminimus" migration of asbestos into human foods. (FDA)	Original regulations assured that migration to food would be "virtually nil" under the conditions of use. Further reductions would require new estimates of how much asbestos is actually getting into food and development of appropriately sensitive detection methods. (FDA)	21 CFR 175.105 177.2420 177.2410 177.2600 (FDA)
		Dental filling material, particularly temporary cements (FDA)		Unknown (many dental patients) (FDA)	Oral (FDA)	Not known (FDA)		FDA - Bureau of Medical Devices Food, Drug, and Cosmetic Act. No regulatory history and no regulations issued to date (FDA)		
			Asbestos miners, auto mechanics, break lining workers, carpenters, electricians, insulation workers, laggers, masons, painters, refitters, shingle makers, shipwrights, steamfitters, textile workers, vinyl asbestos tile workers (OSHA)	2,466,000 workers exposed (OSHA) NIOSH estimates 2.5 x 10^6 persons exposed (NIOSH)	Inhalation ingestion (OSHA)			PEL-2 fibers/cc > 5 um in length 8 hr TWA 10 fibers/cc>5 um in length ceiling (OSHA) Medical surveillance requirements for workers, monitoring requirements, housekeeping and waste disposal requirements, protective clothing, respirator, and change room requirements in areas where engineering and work practice controls are not sufficient to lower asbestos to permissible levels, sign requirements for regulated areas. (OSHA)	1951 Walsh-Healy 5 mppcf maximum allowable concentration August 27, 1971 OSHA Takeover Standard Tremolite 20 mppcf or 20 mg/m^3 % SIO 8 hr TWA asbestos 12 fibers/cc>5 um in length or 2 mppcf 8 hr TWA December 7, 1971 Emergency Temporary Standard 5 fibers/cc>5 um in length 8 hr TWA 10 fibers/ cc>0.5 um in length ceiling permissible for up to 15 min/hr, 5 hr/day January 11, 1972 Standard coverage expanded to include ship repairing, shipbuilding, shipbreaking and longshore workers July 7, 1972 Final standard 5 fibers/cc>5 um in length 8 hr TWA 10 fibers/cc>5 um in length ceiling July 1, 1976 Current limit effective (OSHA)	29 CFR 1910.1001 (OSHA)

Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Exposure					Regulation		
			Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Degree		Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
						Level of Exposure	Frequency of Exposure			
Auramine 492-80-8	Domestic: None reported (EPA) Imports: 500 lb. Two importers in one SFR Public Record only (EPA)	Dyes and dye intermediates (CPSC)	Exposure to residual dyes on textiles, paper, leather, etc. (CPSC)	3, 000 workers exposed (OSHA)	Dermal (CPSC)			Regulated by general duty clause (OSHA) Action deferred until completion of Interagency Testing Committee dye evaluation project (CPSC) NIOSH Special Hazard Review in preparation (NIOSH) The Interagency Testing Committee is considering a number of chemicals used in dyemaking for test rule recommendations, because of the general inadequacy of risk data regarding this use category of chemicals. Some test rule recommendations have been made, and more may follow. (EPA)		PL 91-596 Section 5 (a)(1) (OSHA)

Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Exposure					Regulation		
						Degree				
			Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Level of Exposure	Frequency of Exposure	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
Benzene 71-43-2	Domestic 16,207,711,500 lbs* Imports 2,815,501,500 lbs* 97 producers and importers in 10 SFR s Public record only (EPA) 11 million gallons of consumer products containing at least 0.1% benzene as a contaminant (CPSC) *some site limitations	Exists as a contaminant in consumer products containing petroleum distillates; no longer used as intentional ingredient (CPSC)	Adhesive makers, asbestos products impregnators, benzene hexachloride makers, burnishers, carbolic acid makers, chemists, chlorinated benzene workers, detergent makers, dry battery makers, dye makers, furniture finishers, glue makers, linoleum makers, maleic acid makers, nitrobenzene makers, petrochemical workers, putty makers, rubber makers, styrene makers, welders (OSHA) Coke and gas workers, printing and lithography process workers, dry cleaning workers, gasoline attendants, pesticide producers (NIOSH)	2,976,000 workers exposed (OSHA) 20×10^6 persons annually exposed to consumer products; assuming 1 unit per person/yr (CPSC)	Inhalation of vapor, percutaneous absorption (CPSC) (OSHA)			Hazardous spill regulation designating harmful quantity, requiring reporting of spills, and imposing penalties. (EPA)	Regulation promulgated October, 1979. Goal is to encourage greater care in handling and shipment to prevent releases. Does not address carcinogenicity. (EPA)	40 CFR 117 (EPA)
								Water quality criteria (EPA)	Proposed 3/79. Too early to evaluate effect. Subject to revision in final (EPA)	44 FR 52, p 15926 et seq. (EPA)
								Listed for phased National Emission Standards for Hazardous Air Pollutants. (EPA)	First of several proposed rules in final review. These will be proposed as engineering controls in several industries from which benzene is emitted into the air. Other rules will follow during the next two years. (EPA)	42 FR 110, p 29332-3 (EPA)
								PEL: 1 ppm 8 hr TWA 5 ppm 5 min TWA, ceiling, no skin or eye contact with benzene liquid. Regulation stayed, appeal pending U.S. Supreme Court. Protective clothing, respirator, training and medical surveillance requirements for workers, monitoring requirements, sign requirements for regulated areas, labelling requirements for containers. (OSHA)	August 27, 1971 OSHA Takeover Standard 10 ppm 8 hr TWA May 21, 1977 Emergency Temporary Standard 1 ppm 8 hr TWA 5 ppm 15 min TWA ceiling February 10, 1978 Current standard promulgated. (OSHA)	29 CFR 1910.1028 (OSHA)
								Proposed ban under CPSA of benzene as intentional ingredient in consumer products and of products containing 0.1% or more by volume of benzene as contaminant. (CPSC)	Perhaps as a result of proposed ban, 400,000-800,000 persons no longer exposed (CPSC)	FR 43: 98, 21838-21894 (1978) (CPSC)
								Under FHSA, household products containing 5% or more benzene by weight must bear cautionary labelling. (CPSC)	Difficult to assess effectiveness of labelling (CPSC)	1600 CFR 1500.14 (a) (3), (b) (3) (CPSC)
								Safety packaging required under PPPA for prepackaged liquid solvents, paints, etc. that contain 10% or more benzene by weight and have viscosity less than 100 SUS at 100° F. (CPSC)	Overall safety packaging effectiveness estimated 35% over 3 year period--not able to assess poisoning reduction from benzene products per se. (CPSC)	1600 CFR 1700.14 (a) (13) (CPSC)

			Exposure					Regulation		
						Degree				
Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Level of Exposure	Frequency of Exposure	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
Benzidine 92-87-5	Domestic 500 lbs Imports None reported 1 producer in 1 SFR Public record only (EPA)	Not used commercially in consumer products. May exist as a contaminant in benzidine based dyes (CPSC)	Biochemists, dye workers, medical laboratory workers, organic chemical synthesizers, plastic workers, rubber workers, wood chemists synthesizers, plastic workers, rubber workers, wood chemists (OSHA)	86,000 workers exposed (OSHA) Consumer exposure to residual levels in benzidine based dyes (CPSC)	Inhalation Percutaneous absorption Ingestion of dust (OSHA)			Toxic pollutant effluent standards (EPA)	Manufacture has dropped considerably since 1977 promulgation (EPA)	40 CFR 129.104 (EPA)
								Water quality criteria (EPA)	Proposed 10/79. Too early to evaluate effect. Subject to revision in final (EPA)	44 FR 191, p. 56628 et seq. (EPA)
								PEL: Lowest Feasible Level Protective clothing, respirators, hygiene, training and medical surveillance requirements for workers, exhaust fan requirements, open vessel operations prohibited; contamination control requirements, sign requirements for areas, labelling requirements for containers. (OSHA)	May 18, 1973 Emergency Temporary Standard Protective clothing and hygiene requirements for workers, open vessel operations restricted, engineering requirements February 11, 1974 Final standard current regulations effective (OSHA)	29 CFR 1910.1010 (OSHA)

Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Exposure					Regulation		
			Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Degree		Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
						Level of Exposure	Frequency of Exposure			
Bis (chloromethyl) ether 542-88-1	Domestic: Aggregate production in lbs--550,000 Public record only Imports: None reported One producer in 1 SFR (EPA)	Arise as possible metabolites of some dental restorative materials (FDA)		10^5/year, dental patients (FDA)	Oral (FDA)	Very low (FDA)	Yearly or less assuming a peak metabolic accessability. Environmental persistence; hours or less (decomposes in water) (FDA)	FDA Bureau of Medical Devices; Food, Drug, and Cosmetic Act; no regulations promulgated by FDA-BMD (FDA)		
			Ion exchange resin makers, laboratory workers, organic chemical synthesizers, polymer makers (OSHA)		Inhalation of vapors (percutaneous absorption) (OSHA)			PEL: Lowest Feasible Level Protective clothing, respirator, hygiene, training and medical surveillance requirements for workers; exhaust fan requirements, open vessel operations prohibited; contamination control requirements; sign requirements for areas; labelling requirements for containers. (OSHA)	May 18, 1973 Emergency Temporary Standard. Protective clothing and hygiene requirements for workers; open vessel operations restricted; engineering requirements. February 11, 1974 Final standard current regulations effective (OSHA)	29 CFR 1910.1008 (OSHA)
								Water quality criteria (for chloroalkyl ethers) (EPA)	Proposed 10/79. Too early to evaluate effect. Subject to revision in final. Specifically addresses BCME (EPA)	44 FR 191 p. 56628 et seq. (EPA)

Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Exposure				
			Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Degree	
						Level of Exposure	Frequency of Exposure
Cadmium 7440-43-9	Domestic: 25,199,000* lbs Imports: 3,153,000* lbs *some site limitations Production data aggregated for Cadmium, cadmium carbonate, cadmium acetate, cadmium oxide, cadmium sulfide, cadmium chloride, cadmium sulfate, cadmium nitrate, cadmium fluoborate 63 producers and importers in 10 SFR s Public record only (EPA) $4\text{-}5 \times 10^6$ lbs/yr used in solder exclusively for jewlery and silver smithing degree of consumer use unknown 1×10^6 kg/yr used in plastic stabilizers (CPSC)	Electroplating, soldering plastic stabilizers (CPSC)	Young adult male		Diet	0.05-0.14 ppm	
			Toddlers		Diet	0.05-0.08 ppm	
			Infants		Diet	0.05-0.10 ppm	
			(EPA, FDA)		(EPA, FDA)	(EPA, FDA)	
			Above based on two week prepared samples; not translated to mg/kg body weight				
			Alloy makers, battery makers, dental amalgam makers, engravers, metalizers, paintmakers, pesticide workers, solder workers, textile printers, welders, zinc refiners (OSHA)	$100\text{-}200 \times 10^6$ persons exposed to electroplated products. Exposure to Cadmium from such products unknown (CPSC) 359,000 workers exposed (OSHA)	Inhalation of fumes or dust, ingestion of fumes or dust (OSHA)		

Substance (CAS #)	Regulation		
	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
Cadmium 7440-43-9	Interim primary drinking water regulation (EPA)	Establishes maximum contaminant level of 0.010 mg/l. Does not address carcinogenicity. Under review, and may be revised (EPA)	40 CFR 141.11 (EPA)
	Effluent guidelines for certain industrial categories (EPA)	Establishes control over cadmium in certain effluents through permits issued under NPDES. Carcinogenicity is not a factor in developing these guidelines. (EPA)	40 CFR 413, 421, 440 (portions) (EPA)
	Water quality criteria (EPA)	Proposed 3/79. Too early to evaluate effect. Subject to revision in final (EPA)	44 FR 52, p. 15926 et seq. (EPA)
	RPAR issued against cadmium containing pesticides (EPA)	Rebuttal data are under review. Further action deferred because of lack of resources (EPA)	42 FR 206, p. 5657 et seq. (EPA)
	CPSC staff investigation of solder use in progress (CPSC)		
	(1976) NIOSH recommended standard; for cadmium and all cadmium compounds 40 $\mu g/m^3$ TWA; 200 $\mu g/m^3$ 15 min. ceiling (NIOSH)		

Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Exposure					Regulation		
						Degree				
			Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Level of Exposure	Frequency of Exposure	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
Cadmium (continued)		Naturally present in food and drinking water (FDA)		Entire population (FDA)	Oral (FDA)	52 ug/day (estimate) (FDA)	Daily, environmental persistence years (FDA)	FDA - Bureau of Foods; Food, Drug and Cosmetic Act. Cadmium is not regulated as a food or feed additive nor are there tolerances for its occurrences in food and water. No action has been taken on Cadmium as a carcinogen because the data available are not adequate to assess its carcinogenicity via dietary exposure. (FDA)	Limits leaching solutions from pottery and enamel to 0.5 mg (FDA)	CFR 21 7417.02 (FDA)
		Dyes in dental cements and porcelain, tubing, lubricant, and stabilizer for polymers (FDA)		Not known (FDA)	Oral (FDA)	Not known presumed very low (FDA)	Daily environmental persistence years (FDA)	FDA - Bureau of Medical Devices; Food, Drug, and Cosmetic Act No regulatory action at present until a position is clarified on the use of colors in medical devices. No action has been taken on cadmium as a carcinogen because the data are not adequate to assess its carcinogenicity via dietary exposure. (FDA)		
								Permissible Exposure Limits 0.1 mg/m^3 8 hr TWA (fumes) 0.3 mg/m^3 ceiling (fumes) 0.2 mg/m^3 8 hr TWA (dust) 0.6 mg/m^3 ceiling (dust) (OSHA)	1951 Walsh-Healy 0.1 mg/m^3 maximum allowable concentration August 27, 1971 OSHA Takeover Standard current limit effective (OSHA)	29 CFR 1910.1000 (OSHA)

Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Exposure					Regulation		
			Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Degree				
						Level of Exposure	Frequency of Exposure	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
Cadmium acetate 543-90-8	Aggregated under cadmium			NOHS: 600 workers potentially exposed				Hazardous spill regulation designating harmful quantity, requiring reporting of spills and imposing penalties. (EPA)	Regulation promulgated 10/79. Goal is to encourage greater care in handling and shipment to prevent releases. Does not address carcinogenicity. (EPA)	40 CFR 117 (EPA)
								See recommendations for cadmium (NIOSH) See regulations for cadmium. (OSHA)		29 CFR 1910. 1000 (OSHA)
Cadmium sulfate 10124-36-4	Domestic: 1-2 x 10^6 tons used in plastics as stabilizer (CPSC) Imports: none reported	Plastics, pigments for consumer uses (may occur) (CPSC)	Extent of consumer exposure to be determined (CPSC)	NOHS: 25,638 workers potentially exposed				CPSC Staff investigation in progress (CPSC)		
								See recommendations for cadmium (NIOSH) See regulations for cadmium (OSHA)		29 CFR 1910. 1000 (OSHA)
Cadmium sulfide 1306-23-6	Domestic: 1.26 x 10^6 lbs/year for all uses (CPSC) Imports: none reported	Inks, artist colors, also possibly in glass, ceramics, textiles, paper and phosphorescent materials (CPSC)	Consumer exposure to be determined (CPSC)	NOHS: 82,522 workers potentially exposed				Economic study ongoing (CPSC)		
								See recommendations for cadmium (NIOSH) See regulations for cadmium (OSHA)		29 CFR 1910. 1000 (OSHA)

Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Exposure					Regulation		
						Degree				
			Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Level of Exposure	Frequency of Exposure	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
Chloramphenicol 56-75-7	Not reported for the TSCA inventory (EPA)	Antibacterial, antirichettsial drug (FDA)		120,000-150,000 patients/year, 90% of whom are in hospitals when treatment given (FDA)	Oral (FDA)	50-100 mg/kg per day (FDA)	4 times per day orally (FDA)	FDA Bureau of Drugs; Food, Drug and Cosmetic Act. Regulated as a prescription drug. Systemic dosage forms bear physician directed labelling which warns of its cancer causing activity (leukemia) in humans. The topical preparations' label advises that unnecessary exposure be avoided. (FDA)	Warns the physician against indiscriminant use of chloramphenicol because of cancer causing activity. (FDA)	CFR 21 Subchapter D (FDA)
					Topical (FDA)	0.5-1.0% formulation (FDA)	4 times per day (FDA)			
		Illegal use in food producing animals. Legal use in non-food producing animals (FDA)		Unknown (FDA)	Oral (FDA)	Unknown (FDA)		FDA Bureau of Foods; Food, Drug, and Cosmetic Act. Use restricted to non-food producing animals as an antibiotic. BF is aware of illegal use in food producing animals but has no adequate methodology to detect residues and no monitoring is done. (FDA)	Lack of residue monitoring capability prevent FDA from acquiring knowledge about the possible occurrence of residues in food (FDA)	
								Chloramphenicol is not regulated by EPA. As a pharmaceutical it is of secondary interest to EPA. There are no data to indicate that it is present in effluents, emissions, or wastes from pharmaceutical manufacturers. (EPA)		
				4,000 workers exposed (OSHA)				Regulated by the general duty clause (OSHA)		PL 91-596 Section 5 (a) (1) (OSHA)

			Exposure					Regulation		
						Degree				
Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Level of Exposure	Frequency of Exposure	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
Chloromethyl methyl ether 107-30-2	Domestic: 4 producers in 4 SPRs quantity not reported Imports: none reported (EPA) Public record only	Possible metabolites of some dental restorative materials (FDA)		10^5/year dental patients (FDA)	Oral (FDA)	Very low (FDA)	Yearly or less assuming a peak metabolic accessability (FDA) Environmental persistence: hours or less--decomposes in H_2O (FDA)	Food, Drug and Cosmetic Act (FDA-BMD) No regulations promulgated by FDA-BMD (FDA)		
			Organic chemical synthesizers (OSHA)		Inhalation of vapors Percutaneous absorption (OSHA)			PEL - Lowest Feasible Level Protective clothing, respirator, hygiene, training and medical surveillance requirements for workers; exhaust fan requirements; open vessel operations prohibited; contamination control requirements; sign requirements for areas; labelling requirements for containers (OSHA)	May 18, 1973 Emergency Temporary Standard; Protective clothing and hygiene requirements for workers; open vessel operations restricted; engineering requirements February 11, 1974 Final standard current regulations effective (OSHA)	29 CFR 1910.1006 (OSHA)
								Since Bis(chloromethyl) ether is usually a contaminant of chloromethyl methyl ether and most sources cite the contaminant as the source of concern, EPA is primarily addressing Bis chloromethyl ether. Assessments are in progress regarding additional controls in aqueous media and possible air regulations. Actions taken regarding chloroalkyl ethers will undoubtably have implications for chloromethyl methyl ether and Bis chloromethyl ether. (EPA)		

Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Exposure					Regulation		
			Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Degree				
						Level of Exposure	Frequency of Exposure	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
Chromium 7440-47-3	Domestic: 914,457,000 lbs Imports 113,816,500 lbs Production data are aggregated for all products and address chromium, chromium acetate, chromic oxide, chromium trioxide, lead chromate, sodium chromate, potassium dichromate, potassium chromate, strontium chromate, barium chromate, sodium dichromate 95 producers and importers in 7 SFR s Public record only (EPA)	Widely used in electroplated products (CPSC)	Anodizers, copper etchers electroplaters, glass workers, lithographers, metal workers, oil purifiers, photographers, photogravers, process engravers, stainless steel, workers, textile workers, welders (OSHA)	200 x 10^6 persons exposed to electroplated products (CPSC) 4,412,000 workers (OSHA)	Percutaneous absorption Inhalation Ingestion (OSHA)			PEL: 0.1 mg/m^3 ceiling (chromic acid and chromates) 0.5 mg/m^3 8 hr TWA (sol chromicous salts) 1 mg/m^3 8 hr TWA (metal and insol salts) (OSHA)	1952 Walsh-Healy 0.1 mg/m^3 maximum allowable concentrations (chromic acid and chromates) August 27, 1971 OSHA Takeover standard current limit effective (OSHA)	29 CFR 1910.1000 (OSHA)
		Trace element naturally occurring in food and water. Used as an adhesive additive and pigment for rubber products (FDA)		Entire population (FDA)	Oral (FDA)	Low 5.3 ug/day (estimate) (FDA)	Daily; environmental persistence; years (FDA)	FDA - BF No specific regulations or tolerances for dietary exposure. No action has been taken on chromium as a carcinogen because the data available are not adequate to assess its carcinogenicity via dietary exposure. (FDA)	Not applicable for dietary sources. Regulated uses are based on an assumption that "nil" migration of chromium will occur. (FDA)	Regulated under 21 CFR 175.105 for adhesives, and 21 CFR 177.2600 for rubber products (FDA)
		Salts liberated from corrosion of alloys in implants cranioplasty plates and orthopedic implants (FDA)		10^4 ear, nose and throat patients; 10^5 dental patients 10^8 cardiovascular patients 10^4 cranioplasty plates 2 x 10^5 orthopedic implants (FDA)	Implantation (FDA)	Unknown; presumed low (FDA)	Daily (FDA)	FDA - Bureau of Medical Devices; Food, Drug, and Cosmetic Act. No regulations have been promulgated testing the carcinogenic potential of chromium salts liberated by corrosion has been suggested to NCI. (FDA)	Not applicable (FDA)	
								Interim primary drinking water regulation (EPA)	Established maximum contaminant level of 0.05 mg/l. Carcinogenicity of hexavalent chromium was considered. (EPA)	40 CFR 141.11 (EPA)

Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Exposure					Regulation		
			Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Degree				
						Level of Exposure	Frequency of Exposure	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
Chromium (continued)								Effluent guidelines for certain industrial categories (EPA) Water quality criteria (EPA)	Controls chromium (as total and hexavalent) in affluents through permit issued under the NPDES system. Does not address carcinogenicity. The generally higher risks associated with hexavalent chromium were considered. (EPA) Proposed 10/79. Too early to tell. Addresses carcinogenicity of hexavalent chromium. Subject to revision in final. (EPA)	40 CFR 409, 413, 415, 419, 420, 423, 424, 425 (as chrome), 428, 429, (portions), (EPA) 44 FR 191, p 56628, et seq. (EPA)
								Recommendations for chromium (VI) standard for monitoring medical surveillances--respiratory protective clothing, sanitation, housekeeping, labelling for containers, training (NIOSH) PEL: 1 ug/m^3 for carcinogenic Cr(VI) 25 ug/m^3 TWA for other Cr(VI) 50 ug/m^3 ceiling (15 min.) (1975) (NIOSH)		

Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Exposure					Regulation		
			Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Degree		Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
						Level of Exposure	Frequency of Exposure			
Calcium chromate 13765-19-0		Possible use in paint pigments (CPSC)		NOHS: 3,160 workers potentially exposed				Economic study in process (CPSC)		
								See recommended standard for chromium (VI) (NIOSH) See regulations for chromium (OSHA)		29 CFR 1910.1000 (OSHA)
Potassium chromate 7789-00-6	Aggregate under chromium (EPA)			NOHS: 30,620 workers potentially exposed				Hazardous spill regulation designating harmful quantity, requiring reporting of spills, and imposing penalties. (EPA)	Regulation promulgated October, 1979. Goal is to encourage greater care in handling and shipment to prevent releases. Does not address carcinogenicity. (EPA)	40 CFR 117 (EPA)
								See recommended standard for chromium (VI) (NIOSH) See regulations for chromium (OSHA)		29 CFR 1910.1000 (OSHA)
Chromium dioxide 12018-01-8	Domestic: Estimated production for consumer product uses to be determined (CPSC)	Magnetic tapes (CPSC)				To be determined (CPSC)		Economic study in progress (CPSC)		
								See recommended standard for chromium (VI) (NIOSH) See regulations for chromium (OSHA)		29 CFR 1910.1000 (OSHA)
Chromic oxide 1308-38-9	Domestic: Production for consumer products to be determined (CPSC)	May be used in paint, pigment portland cement brick, leather goods (CPSC)		Exposure of consumer to products to be determined (CPSC) NOHS: Chromium oxides; 1,484,752 total number of exposed; total full time persons exposed: 237,451 (potential exposure)				Ongoing economic study (CPSC) See recommended standard for Chromium (VI) (NIOSH)		
								See regulations for chromium (OSHA)		29 CFR 1910.100 (OSHA)

			Exposure					Regulation		
						Degree				
Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Level of Exposure	Frequency of Exposure	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
Potassium dichromate 7778-50-9	Aggregated under chromium (FDA)			NOHS: 806, 640 workers potentially exposed				Hazardous spill regulation designating harmful quantity, requiring reporting of spills, and imposing penalties. (FDA)	This regulation was promulgated 10/79. Its goal is to encourage greater care in handling and shipment of chemicals. Does not address carcinogenicity. (FDA)	40 CFR 117 (FDA)
								Effluent guidelines for manufacture of potassium dichromate (FDA)	Controls chromium in effluents through permits issued under the NPDES. Carcinogenicity is not a factor in developing effluent guidelines. (FDA)	40 CFR 415 120-126 (FDA)
								See regulations for chromium (OSHA)		29 CFR 1910-1000
								See recommended standard for chromium (VI) (NIOSH)		
Sodium chromate 7775-11-3	Aggregated under chromium (FDA)			NOHS: 92, 148 workers potentially exposed				Hazardous spill regulation designating harmful quantity, requiring reporting of spills, and imposing penalties (FDA)	This regulation was promulgated 10/79. Its goal is to encourage greater care in handling and shipment of chemicals. Does not address carcinogenicity. (FDA)	40 CFR 117 (FDA)
								See regulations for chromium (OSHA)		29 CFR 1910-1000 (OSHA)
								See recommended standard for chromium (VI) (NIOSH)		

Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Exposure					Regulation		
			Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Degree		Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
						Level of Exposure	Frequency of Exposure			
Sodium dichromate 10588-01-9	Aggregated under chromium (EPA)	Leather tanning, roofing materials, chrome pigments used in paints, printing inks for coloring paper, in rubber, in linoleum and in floor tiles (CPSC)		Estimated current exposure to be determined (CPSC) NOHS: 58, 169 workers potentially exposed				Economic study underway (CPSC) Hazardous spill regulation designating harmful quantity requiring reporting of spills, and imposing penalties (EPA) Effluent guidelines for manufacture of sodium dichromate (EPA)	This regulation was promulgated 10/79. Its goal is to encourage greater care in handling and shipment of chemicals. Does not address carcinogenicity. (EPA) Controls chromium in effluents through permits issued under the NPDES. Carcinogenicity is not a factor in developing effluent guidelines. (EPA)	40 CFR 117 (EPA) 40 CFR 415 170-176 (EPA)
								See regulations for chromium (OSHA)		29 CFR 1910-1000 (OSHA)
								See recommended standard for Chromium (VI) (NIOSH)		
Strontium chromate 7789-06-2	Aggregated under chromium (EPA)			NOHS: 71, 864 workers potentially exposed				Hazardous spill regulation designating harmful quantity, requiring reporting of spills, and imposing penalties. (EPA)	Regulation promulgated October, 1979. Goal is to encourage greater care in handling and shipment to prevent releases. Does not address carcinogenicity. (EPA)	40 CFR 117 (EPA)
								See regulations for chromium (OSHA)		29 CFR 1910-1000 (OSHA)
								See recommended standard for Chromium (VI) (NIOSH)		

Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Exposure					Regulation		
			Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Degree				
						Level of Exposure	Frequency of Exposure	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
Cyclophosphamide 50-18-0	Not reported for TSCA inventory (EPA)	Human drug for treatment of myeloproliferative disorders solid malignancies. Investigative use for immunosuppressive non-malignant disease such as rhematoid arthritis, chronic glomerularnephrosis, and nephrotic syndrome (FDA)		200,000-300,000 patients/year (FDA)	Oral, Interperitoneal (FDA)	1-5 mg/kg/day (FDA)		FDA Bureau of Drugs; Food, Drug and Cosmetic Act Prescription drug use for treatment of neoplasias. The package insert has clear warnings of the induction of secondary malignancies which may occur several years after treatment has discontinued. (FDA)	Provides a mode of treatment that will prolong the life of cancer patients. The physician is provided with information required for a benefit vs. risk assessment on each patient. (FDA) Use in non-malignant diseases is investigational but could allow exposure of very young children, young adults and adults to doses which might induce future malignancies. (FDA) More rigorous education of physicians in this danger may be advisable. (FDA)	CFR 21 Subchapter D (FDA)
								Regulated by general duty clause (OSHA)		PL 91-596 Section 5 (a)(1) (OSHA)
								As a pharmaceutical, cyclophosphamide is of secondary regulatory interest to EPA. The Agency has no data to indicate its presence in effluents or emissions from pharmaceutical manufacturers. This chemical was proposed for listing as a hazardous waste in December 1978. (EPA)		43 FR 243, p. 58954 et seq (EPA)

			Exposure					Regulation		
						Degree				
Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Level of Exposure	Frequency of Exposure	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
Diethylstilbestrol 56-53-1	Not reported for TSCA inventory (EPA)	Growth promotant for cattle and sheep which becomes a residue in edible meat (FDA)		Entire population (FDA)	Oral (FDA)	less than 10 ppb (FDA)	Daily (FDA)	Because DES has been shown to be a carcinogen in animals and has been associated with carcinogenesis in humans, a regulation was published in the Federal Register (FR 44: 39387) on July 6, 1979 to revoke all use of DES in food-producing animals. On August 3, 1979 a stay of the effective date for revoking DES until November 3, 1979 was published in the Federal Register. There are presently two court actions before the Court of Appeals for the District of Columbia. (FDA)	Completely remove the risk of continuous exposure to DES as a residue in meat and meat products. (FDA)	FR 44:39387 (FDA)
		Prescribed for threatened abortion, menopause, vasomotor symptoms, atrophic vaginitis, kraurosis vulvae, female castration, primary ovary failure, breast cancer, uterine bleeding, and post-partum breast engorgement, also prostrate cancer in males. (FDA)		Over 500,000/year with two-thirds of use in hospitals. Most hospitals use it for treatment of neoplastic disease on a continuous basis. Most neoplastic patients are male. (FDA)		1-15 mg/day (FDA)	Daily (FDA)	In late 40s and early 50s DES was prescribed extensively for threatened abortion. This use declined as epidemiology studies demonstrated DES to be ineffective in preventing abortion accidents. In 1971 further epidemiologic data proved a relationship between DES intrauterine exposure and clear cell adenocarcinoma of the vagina of female offspring. FDA has since required product labeling to state that DES is contraindicated for use in pregnancy. Dispensing an estrogen patient package insert with each new prescription became a regulation in 1977. Special estrogen labeling is required to be supplied to physicians which details the risks involved with administering estrogens. FDA Bureau of Drugs; Food, Drug, and Cosmetic Act (FDA)	The use of DES in pregnant women is listed as contraindicated. Special patient package inserts and physician estrogen labeling information is required by regulation. The use of such education material will inform both the patient and the doctor of the risks associated with DES. (FDA)	CFR 21 Subchapter D (FDA)
				Number of workers exposed: 4,000 (OSHA)				Regulated by the general duty clause (OSHA)		PL 91-596, Section 5(a)(1) (OSHA)
								As a food additive and pharmaceutical, DES is of secondary regulatory interest to EPA. The Agency has no data to indicate its presence in effluents or emissions from appropriate manufacturers. This chemical was proposed for listing as a hazardous waste in December 1978. (EPA)		43 FR 243, p. 58954 et seq (EPA)

			Exposure					Regulation		
						Degree				
Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Level of Exposure	Frequency of Exposure	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
Hematite 1309-37-1	Domestic 1,135,632,000* Imports: 711,022,500 lb.* Public record only 71 producers and importers in 10 SFR s (EPA) * some site limitations							Hematite is viewed by EPA as primarily within the jurisdiction of MHSA (extraction and milling) or OSHA (iron production). Some effluent guidelines address the ferric ore mining, milling and refining categories but do not address hematite per se. Control of total suspended solids may afford some control of pollution. In view of the indication that the primary cancer risk is to workers, it is unlikely that EPA will assume further jurisdiction over hematite. (EPA)		
		To color dental restoratives (FDA)			Oral (FDA)	Very low (FDA) Environmentally persistent for years		FDA Bureau of Drugs; Food, Drug & Cosmetic Act; not regulated (FDA)		
								Regulated by the general duty clause (OSHA)		PL 91-596 Section 5(a)(1) (OSHA)
Isopropyl oils No CAS # Isopropyl alcohol 67-63-0	Domestic: Isopropyl alcohol-- 750,610,500* Imports: 35,623,500 lb.* Public record only M Producers and importers in 7 SFR s (EPA) * some site limitations	Note: Isopropyl oils are by-products in the production of isopropyl alcohol; there is no indication that they are recovered as having commercial value. (EPA)	Working atmosphere for manufacture of isopropyl alcohol (EPA)					The particular hazard cited is associated with the workplace, and is therefore under OSHA jurisdiction. EPA has no data to indicate that isopropyl oils are present in effluents, emissions or wastes from production facilities where isopropyl alcohol is made by the strong acid process. (EPA)		
								Regulated by General Duty Clause (OSHA)		PL 91-596 Sec. 5 (a)(1) (OSHA)
								Recommended standard for isopropyl alcohol (1976) 400 ppm TWA (984 mg/m^3) 800 ppm ceiling (1968 mg/m^3) 15 minutes (NIOSH)		

			Exposure					Regulation		
						Degree				
Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Level of Exposure	Frequency of Exposure	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
Melphalan 531-76-0	Not reported for TSCA inventory (EPA)	Treatment of multiple myeloma and epithelial ovarian cancer (FDA)		30,000-50,000/yr. (FDA)	Oral, I.V. (FDA)	6 mg/day (FDA)	5 days per month (FDA)	FDA Bureau of Drugs Food, Drug, and Cosmetic Act Approved drug for treatment of myeloma and epithelial ovarian cancer. Investigational use only for certain other cancers. (FDA)	Use restricted to Bureau of Drugs approved treatments. (FDA)	CFR 21 Subchapter D (FDA)
								Regulated by general duty clause (OSHA)		PL 91-596 Sec. 5(a)(1) (OSHA)
								As a pharmaceutical, melphalan is of secondary regulatory interest to EPA. There are no data to indicate that it is present in effluents, emissions, or wastes from manufacturers. (EPA)		
Mustard gas 505-60-2	Not reported for TSCA inventory (EPA)							As a chemical warfare agent, would be excluded under national security clauses in regulatory legislation. There are no indications of commercial scale manufacture that would trigger specific regulatory attention. (EPA)		
								Regulated by general duty clause (OSHA)		PL 91-596 Sec. 5(a)(1) (OSHA)

Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Exposure					Regulation		
			Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Degree				
						Level of Exposure	Frequency of Exposure	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
2-Naphthylamine 91-59-8	Domestic: No longer produced in U.S. (CPSC)	Industrial dyes (CPSC)	Consumer exposure may take place through the loss of dyes from dyed consumer products (CPSC)					Action deferred pending recommendations from Interagency Testing Committee dye evaluation project (CPSC)		
			Types of workers exposed: 2-Naphthylamine workers, research workers (OSHA)		Inhalation Percutaneous absorption (OSHA)			PEL - Lowest Feasible Level protective clothing, respirators, hygiene, training and medical surveillance requirements for workers, exhaust fan requirements, open vessel operations prohibited; contamination control requirements, sign requirements for area; labelling requirements for containers (OSHA)	Regulatory history: May 18, 1973--Emergency temporary standard. Protective clothing and hygiene requirements for workers, open vessel operations restricted, engineering requirements. February 11, 1974--Final standard. Current regulations effective. (OSHA)	29 CFR 1910.1009 (OSHA)
	One company reported for the TSCA inventory, but did not indicate volume. Public record only. (EPA)							Since this substance is not widely manufactured (only one site), EPA is not able to address it at this time. (EPA)		

Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Exposure					Regulation		
			Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Degree		Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
						Level of Exposure	Frequency of Exposure			
Nickel 7440-02-0	Domestic: 168, 883, 000 lb Imports: 424, 748, 000 lb Production data address nickel, anhydrous nickel acetate, nickel oxide, nickel trioxide, nickel carbonate, nickel chloride, nickel sulfate, nickel fluoride, nickel subsulfide, nickelous hydroxide, nickel carbonate hydroxide, nickel carbonyl, nickel sulfamate, nickel ammonium sulfate, nickel sulfide The figures are aggregated for all products; 137 producers and importers in 10 SFR's (EPA) Public record only							Effluent guidelines for certain industrial categories (EPA) Water quality criteria (EPA)	Controls nickel in effluents through permits issued under the NPDES system. Does not address carcinogenicity. (EPA) Proposed 7/79. Does not address carcinogenicity. Subject to revision in final (EPA)	40 CFR 413, 415 (portions) (EPA) 44 FR 144, p. 43660 et seq (EPA)
			Types of workers exposed: batterymakers, ceramic makers, chemists, dyers, enamelers, ink makers, magnet makers, oil hydrogenators, paint makers, pen point makers, spark plug makers, textile dyers, varnish makers (OSHA)	709, 000 workers exposed (OSHA)	Inhalation of dust or fumes (OSHA)			PEL: 0.001 ppm, 0.007 mg/m^3 8 hr TWA (nickel carbonyl) 1 mg/m^3 8 hr TWA (as Ni; metal soluble compounds) (OSHA)	1952 Walsh-Healy 1 ppm (nickel carbonyl) maximum allowable concentration August 27, 1971--OSHA Takeover Standard current limit effective (OSHA)	29 CFR 1910. 1000 (OSHA)
			Nickel catalyst users, makers of Ni alloys, battery makers, cemented carbide makers, ceramic makers, jewelers, welders, dyers, magnet makers (NIOSH)	250, 000 exposures (NIOSH)				Recommended standard for inorganic nickel (1977) containing recommendations for medical surveillance, labelling and posting, personal protective clothing and equipment, work practices, monitoring of workplace air, employee education. PEL: 15 ug Ni/m^3 10 hr TWA (NIOSH)		
		Naturally occurring trace element in food and water. Trace amounts may enter food from use of stainless steel cookware. (FDA)		Entire population for naturally occurring nickel in food. (FDA)	Oral (FDA)	300-600 ug/day from food and water. (FDA)	Daily (FDA)	FDA - Bureau of Foods Bureau of Medical Devices Food, Drug, and Cosmetic Act Not regulated as a food additive. No regulations on nickel present in implants. (FDA)		

Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Exposure					Regulation		
			Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Degree		Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
						Level of Exposure	Frequency of Exposure			
Nickel (continued)		Stainless steel implants and other alloys may expose patients. (FDA)		Stainless steel implants 10[illegible] cardiovascular patients 10^7 nose and ear patients 10^5 orthopedic patients (FDA)	Implant (FDA)	Implant exposure not known (FDA)		No action has been taken on nickel as a carcinogen because the data available are not adequate to assess its carcinogenicity via dietary exposure. (FDA)		
Nickel carbonyl 13463-39-3	Aggregated under nickel (EPA)							Nickel carbonyl is being assessed under Clean Air Act authorities; especially it has been cited as a possible contaminant of diesel fuel, and present in exhaust from diesel vehicles. To date, tests are inconclusive. (EPA)		
			Metallurgists, nickel vapor plating workers, ethyl acrylate monomer makers (NIOSH)					PEL 7 ug/m^3 (1 ppb) 8 hr TWA (OSHA) Special Hazard Review containing recommendations for medical surveillance, sanitation engineering, signs for regulated areas, personal protective clothing and equipment, record-keeping requirements and recommended Permissible Exposure Level 7 ug/m^3 (1 ppb) TWA. (NIOSH)		29 CFR 1910.1000 (OSHA)
Nickel chloride 7718-54-9	Aggregated under nickel (EPA)			NOHS: 12,020 workers potentially exposed				Hazardous spill regulation designating harmful quantity, requiring reporting of spills, and imposing penalties. (EPA)	Regulation promulgated October, 1979. Goal is to encourage greater care in handling and shipment to prevent releases. Does not address carcinogenicity. (EPA)	40 CFR 117 (EPA)
								See nickel (NIOSH) See nickel regulation (OSHA)		29 CFR 1910.1000 (OSHA)
Nickel hydroxide 12054-48-7	Aggregated under nickel (EPA)							Hazardous spill regulation designating harmful quantity, requiring reporting of spills, and imposing penalties. (EPA)	Regulation promulgated October 1979. Goal is to encourage greater care in handling and shipment to prevent releases. Does not address carcinogenicity. (EPA)	40 CFR 117 (EPA)
								See nickel (NIOSH) See nickel regulation (OSHA)		29 CFR 1910.1000 (OSHA)

			Exposure					Regulation		
						Degree				
Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Level of Exposure	Frequency of Exposure	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
Nickel sulfate 7786-81-4	Aggregated under Nickel (EPA)			NOHS: 20,527 workers potentially exposed				Hazardous spill regulation designating harmful quantity, requiring reporting of spills, and imposing penalties. (EPA)	Regulation promulgated October, 1979. Goal is to encourage greater care in handling and shipment to prevent releases. Does not address carcinogenicity. (EPA)	40 CFR 117 (EPA)
								See nickel (NIOSH) See regulation for nickel (OSHA)		CFR 29 1019.1000 (OSHA)
Nickel ammonium sulfate 15699-18-0	Aggregated under nickel (EPA)							Hazardous spill regulation designating harmful quantity, requiring reporting of spills, and imposing penalties. (EPA)	Regulation promulgated October, 1979. Goal is to encourage greater care in handling and shipment to prevent releases. Does not address carcinogenicity. (EPA)	40 CFR 117 (EPA)
								See Nickel (NIOSH) See regulation for nickel (OSHA)		CFR 29 1910.1000 (OSHA)
N, N-Bis (2-chloroethyl)-2 naphthylamine 494-03-1	Not reported for TSCA inventory (EPA)	Principal use as a pharmaceutical (EPA)						Not being produced or used in the United States as a pharmaceutical; is not of concern to EPA at this time. (EPA)		
								Regulated by the general duty clause (OSHA)		PL 91-596 Section 5(a)(1) (NIOSH)
Oxymetholone 434-07-1	Not reported for TSCA inventory (EPA)	Principal use as a pharmaceutical (EPA)						As a pharmaceutical, oxymetholone is of secondary regulatory interest to EPA. Since it is apparently imported and not manufactured in this country, it is unlikely that EPA will investigate it for possible regulation. (EPA)		

Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Exposure					Regulation		
			Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Degree				
						Level of Exposure	Frequency of Exposure	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
Oxymetholone		Adjuvant therapy in senile and post-menopausal osteolporocis; previous to 1972 used for treatment of anemia (FDA)		30,000 to 100,000 patients/year (FDA)	Oral (FDA)	1-5 mg per kg (FDA)	Daily (FDA)	Oxymetholone at indicated only for treatment of anemia caused by deficient red blood cell production, and was approved in 1972 for safety and effectiveness. Since 1972 all indications except "probably" effective as adjuvant therapy in senile and postmenopausal osteolporocis have been deleted from the labeling pending further investigation of this less than effective indication (FDA)	In 1972, FDA required a labeling revision in the adverse reaction section that would include a statement on the occurence of heptocellular neoplasms and peliosis hepatis in association with anabolic androgenic therapy (FDA)	CFR 21 Subchapter D (FDA)
								Regulated by the general duty clause. (OSHA)		PL 91-596 Section 5(a)(1) (OSHA)
Phenacetin 62-44-2	Domestic: 550,000 lb. Imports: 55,000 lb. 7 producers and importers in 3 SFRs Public Record only (EPA)	Over the counter (OTC) analgesic and antipyretic (FDA) Stabilizer for hydrogen peroxide (indications are that this is only in veterinary products) (EPA)		Potentially entire population (FDA)	Oral (FDA)	1 gram/day (FDA)	As needed (FDA)	FDA Bureau of Drugs Food, Drug and Cosmetic Act. Phenacetin has been reviewed by the Advisory Review Panel on OTC Internal Analgesic, antipyretic, and antirheumatic products and categories as an effective OTC analgesic and antipyretic but not safe for OTC use. The FDA has initiated administrative proceedings to accomplish this but objections have been raised concerning the validity of the carcinogenesis data. The FDA is thus not in a position, at the present time, to call phenacetin a known human carcinogen. It can class it as an animal carcinogen with some human data available but inadequate to permit human carcinogenicity evaluation. (FDA)	The proposed action would remove phenacitin from over-the-counter (OTC) preparations. (FDA)	Recommendation of OTC Internal Advisory Review Panel for analgesics, anti-pyretics, and anti-rheumatics products (FDA)
								Regulated by general duty clause. (OSHA)		PL 91-596 Section 5(a)(1) (OSHA)
								As a pharmaceutical, phenacetin is of secondary regulatory interest to EPA. There are no data to indicate that it is present in effluents, emissions, or wastes from pharmaceutical manufacturers. (EPA)		

			Exposure					Regulation		
						Degree				
Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Level of Exposure	Frequency of Exposure	Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
Phenytoin 57-41-0	Domestic note: IARC monographs included monosodium salt: production reported for this compound for imports only Public record only (EPA) 3 producers and importers in 2 SFRs (EPA) Domestic: 300 lb. Phenytoin was not reported for the TSCA inventory (EPA)	Prescription drug for control of grand mal convulsive seizures, and status epilepticus (FDA)		Not available at present time but can assume a major segment of the epileptic population would be exposed.	Oral and parenteral (FDA)	300 mg/day orally I.V. 200-350 mg/day (FDA)		FDA Bureau of Drugs; Food, Drug and Cosmetic Act Regulated as a prescription drug. The Bureau of Drugs points out that the scientific data are not conclusive to call phenytoin a "known human carcinogen." The problem has been sent to an Advisory Committee and their recommendation will be considered before any statement is issued from FDA. (FDA)	No specific regulatory action will be taken until an advisory opinion has been submitted. (FDA)	CFR 21, Subchapter D (FDA)
								Regulated by general duty clause (OSHA)		PL 91-596 Section 5(a)(1) (OSHA)
								As a pharmaceutical, phenytoin is of secondary regulatory interest to EPA. There are no data to indicate that it is present in effluents, emissions, or wastes from pharmaceutical manufacturers. (EPA)		
Soots, tars and oils	Production data, pesticides, coal tar (1975) - 34,847,000 lb; coal tar neutral oil (1975) 2,019,000 lb; creosote (1976) 948,000,000 lb (EPA)							RPAR issued regarding pesticides containing these 3 substances: coal tar, coal tar neutral oil, creosote. (EPA)	Rebuttal data under review. Notice of proposed determination, June 1980. (EPA)	43 FR202, P48154 et seq. (EPA)
				Number of workers exposed: 121,000 (tars) (OSHA)				PEL 0.2 mg/m^3 8 hr. TWA (coal tar pitch volatiles) (OSHA)		29 CFR 1910.1000 (OSHA)
Petrolatum and Mineral Oils		Release agent in bakery and confection products and as a protective coating on fruits and vegetables (FDA)		Entire population (FDA)	Oral (FDA)	50 mg/day (FDA)	Daily (FDA)	FDA Bureau of Foods. Must meet specifications given in CFR. (FDA)	Limits the amount of polynuclear aromatic hydrocarbons that may be present to "nil." (FDA)	21 CFR 171.878 21 CFR 171.880 (FDA)

Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Exposure					Regulation		
			Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Degree		Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
						Level of Exposure	Frequency of Exposure			
Soots, Tars and Oils (continued) Carbon Black		As a pigment in food containers, molded articles, and rubber articles (FDA)			Oral (FDA)	Very low (FDA)	Daily (FDA)	FDA Bureau of Foods; Food, Drug and Cosmetic Act, limits the migration of carbon black used in food packages and manufactured articles to "nil" and prohibits use of carbon blacks which contain PNAH (FDA)	Prohibits use of carbon blacks which would result in release (FDA)	21 CFR 175.2 (FDA)
Carbon Black (Channel Black)		As a color additive for foods, drugs, and cosmetics (FDA)		Entire population (FDA)	Oral (FDA)		Daily (FDA)	FDA Bureau of Foods; Commercially used prior to 1960 Provisional listing 1960 Listing terminated 1976 (FDA)	Prohibits use of carbon blacks in foods, drugs, and cosmetics (lack of safety). No adequate method to measure polynuclear aromatic hydrocarbons. (FDA)	41 FR 41857 21 CFR 81.10 (g) (FDA)
								Recommended standard (1978) PEL; 3.5 mg/m^3 (0.1 mg/m^3 in presence of polycyclic hydrocarbons. (FDA)		
Coal tar 8007-45-2	Domestic: 34,847,000 lb (1975)	To treat skin disorders (FDA)			Topical (FDA)	.1 - .01 gm/application (FDA)	Bi-weekly (varies) (FDA)	FDA Bureau of Drugs; most products are OTC; they are currently under review for safety, efficacy and labeling. (FDA)	Present labeling will be upgraded to limit suggested usage (FDA)	CFR 21 Subchapter D (FDA)
Coal tar Neutral oil Coal tar Coke oven emissions	Domestic: 2,019,000 lb. (1975) (EPA)		Coal handlers, coke oven workers, by-product plant workers (NIOSH)	10,000 workers (NIOSH)				Criteria Document: Coal tar products, NIOSH recommendations: engineering controls, medical surveillance, labeling and posting, respirators, training. Recommended standard for coal tar products (1977): 0.1 mg/m^3 in cyclohexane extractable fraction. (NIOSH)	Work practices to minimize exposure to emissions (NIOSH)	
Creosote 8021-39-4	Domestic: 948,000,000 lb (1976) (EPA)	Pesticide use reports (from opp) (EPA)								

Substance (CAS #)	Domestic Production, Imports and Exports	Usage	Exposure					Regulation		
			Types of Population Exposed	NOHS and Other Exposure Estimates	Route	Degree		Regulations and Other Actions	Effect of Regulation and Other Actions	Citation of Regulation
						Level of Exposure	Frequency of Exposure			
Vinyl chloride 75-01-4	Domestic: 6,900,000,000 lbs* 17 producers in 4 SFRs; some site limitations (EPA) 2.4 x 10^9 kg (1973) (FDA) Public record only (EPA) * some site limitations		Polyvinyl resin makers; organic chemical synthesizers; rubber makers (OSHA)	3,547,000 workers exposed (OSHA) Number of populations potentially exposed; 4,600,000 living within 5 miles of NESHAP-regulated facilities (EPA)				National emission standards for hazardous air pollutants addressing VC manufacturing and polymerization and certain ethylene dichloride manufacturing facilities. (EPA)	Imposes engineering controls that have been shown to reduce emissions by 95% over uncontrolled levels (EPA)	40 CFR 61.60-71 (EPA)
								Water quality criteria (EPA)	Proposed 3/79. Subject to revision in final. (EPA)	44 FR 52, p 15926 et seq. (EPA)
								Cancellation/suspension of all pesticides registered for use in homes, food handling areas, hospitals, and enclosed areas (EPA)	Most production for these uses had been ceased prior to this action. It permitted recall of existing stocks (EPA)	40 FR 3934 (EPA)
		Only occurrence in consumer products may be as low-level contaminant in vinyl chloride copolymer and homopolymer resins. Formerly used as propellant for aerosol consumer products. (CPSC)						Ban on use as an aerosol propellant in household products (CPSC)	As a result of bans by CPSC, FDA, EPA 1-5 million persons no longer exposed (CPSC)	1600 CFR 1500.17 (a)(10) (CPSC)
		Present as unreacted monomer (VCM) in PVC products (a) Medical devices (FDA)			I.V. (FDA)	Very Low (FDA)	Yearly or less (FDA)	FDA Bureau of Drugs, Bureau of Medical Devices Any drug products containing VC must pass through the New Drug Application process (FDA)	Has eliminated the use of VC in drug products and as a propellant vehicle in aerosol products (FDA)	39 FR 30830 (1974) (FDA)
		(b) Food containers (FDA)			Oral (FDA)	Very Low (ppb) (FDA)	Daily (FDA)	Bureau of Foods published notice to regulate VCM in packaging material 40 FR 40528 (1975) but rules were not finalized (FDA)	This has alerted manufacturers to the need to monitor their packaging materials for VCM. BATF has banned use of PCV containers for alcoholic beverages based upon FDA work. (FDA)	40 FR 40528 (FDA)

<table>
<tr><th rowspan="3">Substance (CAS #)</th><th rowspan="3">Domestic Production, Imports and Exports</th><th rowspan="3">Usage</th><th colspan="5">Exposure</th><th colspan="3" rowspan="2">Regulation</th></tr>
<tr><th rowspan="2">Types of Population Exposed</th><th rowspan="2">NOHS and Other Exposure Estimates</th><th rowspan="2">Route</th><th colspan="2">Degree</th></tr>
<tr><th>Level of Exposure</th><th>Frequency of Exposure</th><th>Regulations and Other Actions</th><th>Effect of Regulation and Other Actions</th><th>Citation of Regulation</th></tr>
<tr><td>Vinyl chloride (continued)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>PEL
1 ppm 8 hr TWA
5 ppm/15 min TWA ceiling.
No direct contact with liquid.
(OSHA)
Protective clothing, respirator, training, and medical surveillance requirements for workers, monitoring requirements, sign requirements for regulated areas; labeling requirements for containers.
(OSHA)</td><td>1952 Walsh-Healy; 500 ppm maximum allowable concentration
August 27, 1971
OSHA takeover standard 500 ppm, 1300 mg/m^3 ceiling
April 5, 1974 Emergency Temporary Standard 50 ppm ceiling
April 1, 1975 Final standard current limit effective
(OSHA)</td><td>29 CFR 1910.1017
(OSHA)</td></tr>
</table>

F. Requests to DHHS for Testing Chemicals and Their Disposition--and to Provide Information

Section D of this Act states:

> "(D) a description of (i) each request received during the year involved--
>
> "(I) from a Federal agency outside the Department of Health, Education and Welfare to any other entity within the Department, to conduct research into or testing for the carcinogenicity of substances or to provide information described in clause (ii) of subparagraph (C), and (ii) how the Secretary and each such other entity, respectively, have responded to each request."

In Table 1, we have listed those chemicals for which carcinogenicity testing has been requested and their disposition. This table is followed by a legend for the abbreviations used in the table.

It should be noted that in part D of this Act, the requirement is to list information requests and what was specifically asked with respect to estimates of decrease of risk. Table 2 only contains a compilation of requests and their nature. The list includes requests for information about carcinogens (potential or actual), information about hazards of work environments where carcinogens might have been present, and general toxicological profiles where cancer may have been one of the concerns.

Chemicals for which Carcinogenicity Testing has been Requested

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
75-07-0	Acetaldehyde	Ethanal	NCI	Class Study; potential for high exposure; suspicion of carcinogenic activity	CSWG = High CSSG = 4. 1/10
108-24-7	Acetic anhydride	--	NCI	Class Study; unknown suspicion of carcinogenicity; a significant potential for human exposure	CSWG = Moderate CSSG = Pending
75-05-8	Acetonitrile	Cyanomethane; methyl nitrile; methane carbonitrile; methyl cyanide	NCI	Potential for high exposure (found in water supplies)	CSWG = High CSSG = 5. 2/10
79-06-1	Acrylamide	2-Propenamide; ethylenecarboxamide; acrylic amide	NCI	Present in measurable amounts in water supplies	CSWG = Deferred
9003-32-1	Acrylic latexes	Ethyl acrylate copolymer; Rhoplex^{R} HA-8	NCI	Class Study; unknown suspicion of carcinogenicity; potential for significant human exposure	CSWG = Rejected
134-50-9	9-Aminoacridine hydrochloride	Monacrin hydrochloride; aminacrine hydrochloride	NCI	Ranked No. 2142 out of total 3143 chemicals in Mark II exposure ranked list	CSWG = Mod/high CSSG = Pending
81-49-2	1-Amino-2, 4-dibromoanthraquinone	--	NCI	--	Selected for testing
6285-57-0	2-Amino-6-nitrobenzothiazole	6-Nitro-2-benzothiazolamine	NCI	Class Study; potential for human exposure; high suspicion of possible carcinogenicity	CSWG = Still under consideration

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
99-57-0	2-Amino-4-nitrophenol	--	NCI	--	On test at NCI
11120-25-5	Ammonium paratungstate	Ammonium tungstate; APT	NCI	Class Study; representative tungsten with +6 valence; considerable potential for human exposure	CSWG = Deferred
60-15-1	Amphetamine	--	NCI	--	Selected for testing
69-53-4	Ampicillin	--	NCI/OSHA	--	On test at NCI
463-04-7	Amyl nitrite	--	NCI	--	Dropped
--	Antergan	--	FDA	No carcinogenicity testing	NTP = under consideration
7440-36-0	Antimony (metal)	--	EPA/NCI	Large production/exposure	Acted on by NTP
123-77-3	Azodicarbonamine	--	NCI	--	Selected for testing
513-77-9	Barium carbonate	Witherite	NCI	Class Study; CSWG requested nomination of barium compound more soluble than barium sulfate; potential for considerable human exposure	CSWG = High CSSG = Pending
10361-37-2	Barium chloride	--	NCI	Class Study; potential for considerable human exposure	CSWG = High CSSG = Pending

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
7727-43-7	Barium sulfate	Blanc fixe; synthetic barium sulfate	NCI	Class Study; potential for considerable human exposure; largest production of any barium compounds	CSWG = Rejected because considered too insoluble to be tested adequately
1861-40-1	Benefin	Balan^R; N-butyl-N-ethyl-α, α, α-trifluoro-2, 6-dinitro-p-toluene	NCI	Class Study; high suspicion of possible carcinogenicity; potential for considerable human exposure	CSWG = Rejected because already being tested
100-52-7	Benzaldehyde	--	NCI	--	Tentatively selected for testing
1538-09-6	Benzathine penicillin G	--	NCI	Large exposure	Not on test - Penicillin V substituted
510-15-6	Benzilic acid, 4, 4'-dichloroethyl ester	--	NCI	Potential exposure; definite carcinogenic studies lacking	Dropped by NTP (under test)
2634-33-5	1, 2-Benzisothiazolin-3-one	1, 2-Benisothiazolone; Proxel	NCI	Class Study; significant potential for human exposure	CSWG = High CSSG = Pending
271-89-6	Benzofuran	--	OSHA/NCI	--	On test at NCI
100-51-6	Benzyl alcohol	--	OSHA/NCI	--	On test at NCI
120-32-1	o-Benzyl-p-chlorophenol	Chlorophene; 4-chloro-phenyl-o-cresol; Santophen 1	NCI	Class Study; high potential for human exposure	CSWG = Moderate CSSG = Pending

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
63449-41-2	Benzyldimethyl (mixed alkyl)-ammonium chloride	Benzalkonium chloride; BTC; Hyamine 3500; Roccal; Zephiran chloride	NCI	Class Study; significant potential for human exposure	CSWG = Rejected because animal studies appear negative
3081-14-9	N, N'-Bis(1, 4-dimethyl-pentyl)-p-phenylene-diamine	N, N'-Bis(1, 4-dimethyl-pentyl)-1, 4-benzene-diamine; Santoflex 77^{R}	NCI	Class Study; high suspicion of carcinogenicity based on known carcinogenic phenylenediamines; potential for exposure	CSWG = Low CSSG = 4. 0/10 NTP = Under consideration
117-81-7	Bis(2-ethylhexyl)phthalate	--	FDA	Ubiquitous component in medical devices. Chronic studies are lacking	Acted upon by NTP
14882-18-9	Bismuth subsalicylate	Bismuth salicylate; bismuth oxysalicylate	NCI	Class Study; considerable potential for human exposure	CSWG = Rejected because of great insolubility; no longer used extensively
80-05-7	Bisphenol A	--	NIOSH/NCI	--	Tested by NCI
10043-35-3	Boric acid and borates	--	CPSC/EPA/NCI	--	On test at NCI
108-86-1	Bromobenzene	--	OSHA/NCI	--	On test at NCI
1817-73-8	2-Bromo-4, 6-dinitroaniline	6-Bromo-2, 4-dinitro-aniline; 2-bromo-4, 6-dinitrobenzenamine	EPA/NCI	Class Study; potential alkylating agent	CSWG = Moderate CSSG = 2. 2/10 NTP = Under consideration
52-51-7	2-Bromo-2-nitro-1, 3-propanediol	--	NIOSH	Class Study; moderate suspicion of possible carcinogenicity	CSPG = Dropped because inhalational study in progress

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
7166-19-0	β-Bromo- β-nitrostyrene	2-Bromo-2-nitroethenylbenzene	NCI	Class Study; high suspicion of carcinogenic activity; potential for human exposure	CSWG = Moderate CSSG = 5.4/10 NTP = Under consideratio
1338-23-4	2-Butanone-peroxide	--	OSHA/NCI	--	On test at NCI
109-69-3	n-Butyl chloride	--	NCI	--	On test at NCI
109-79-5	n-Butyl mercaptan	1-Butanethiol; n-butyl thioalcohol; 1-mercaptobutane	Department of Defense	Proposed use as a training agent for soldiers	CSWG = Rejected because of uninteresting structure; odor might limit exposure
123-72-8	Butyraldehyde	n-Butyl aldehyde	NCI	Class Study; suspicion of carcinogenicity; significant potential for human exposure; occurrence in water	CSWG = Moderate CSSG = 5.0/10 NTP = Under consideratio
106-31-0	Butyric anhydride	n-Butyric anhydride; n-butyric acid anhydride	NCI	Class Study; unknown suspicion of carcinogenicity; significant potential for human exposure	CSWG = Rejected because of close structure relationship to acetic anhydride (already selected)
96-48-0	gamma-Butyrolactone	--	NCI	--	Selected for testing
523-47-7	beta-Cadinene	--	FDA	--	Selected for testing
10325-94-7	Cadmium nitrate	Cadmium dinitrate	NCI	Class Study; reported carcinogenicity of other cadmium-containing inorganics; significant potential for human exposure	CSWG = Moderate CSSG = 7.4/10 NTP = Under consideratio

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
1306-19-0	Cadmium oxide	Cadmium monoxide	NCI	Class Study; reported carcinogenicity of other cadmium-containing inorganics; significant potential for human exposure	CSWG = Moderate CSSG = 8. 2/10 NTP = Acted upon
1306-24-7	Cadmium selenide	--	NCI	Class Study; reported carcinogenicity of other cadmium-containing inorganics; significant potential for human exposure	CSWG = Moderate CSSG = Deferred
1306-23-6	Cadmium sulfide	--	NCI	Class Study; reported carcinogenicity of other cadmium-containing inorganics; significant potential for human exposure	CSWG = Moderate CSSG = Deferred
58-08-2	Caffeine	--	FDA/NCI	Large exposure	Selected for testing
404-86-4	Capsaicin	--	FDA/NCI	Large production/ exposure	Selected for testing
121-59-5	Cararsone	--	FDA	Potential large exposure due to presence in feed and environment; chemical form of arsenic in tissues unknown; may present health effects.	Executive Summary being prepared

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
75-15-0	Carbon disulfide	--	NIEHS/NCI	Large production/ exposure	Selected for testing
78-44-4	Carisoprodol	N-Isopropyl-2-methyl-2-propyl-1,3-propanediol dicarbamate®	FDA/NCI	Class Study; chronic usage; lack of carcinogenicity data; presence of carbamate moiety in structure	CSWG = Moderate CSSG = 6.2/10 NTP = Under consideratio
99-49-0	Carvone	--	NCI	--	Tentatively selected for testing
120-80-0	Catechol	--	NCI	--	Selected for testing
56-75-7	Chloramphenicol	--	NCI	--	Selected for testing
143-50-0	Chlordecone (Kepone)	--	NCI	--	Tested by NCI; dropped by NTP (banned)
115-28-6	Chlorendic acid	--	OSHA/NCI	--	On test at NCI
--	Chlorinated dibenzofurans	--	EPA	As class, potential teratogen/carcinogen, wide exposure; environmental contaminant	Acted upon by NTP
56802-99-4	Chlorinated trisodium phosphate	--	EPA/CPSC/ NCI	--	On test at NCI
10049-04-4	Chlorine dioxide	Chlorine peroxide; Doxcide 50	NCI	Class Study; considerable potential for human exposure; low-to-moderate suspicion of carcinogenicity	CSWG = Rejected because too reactive to test

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
4080-31-3	N-(3-Chloroallyl)hexaminium chloride	1-(3-Chloroallyl)-3,5,7-triaza-1-azonia-adamantane chloride; Dowicil 75, 100, 200; Quaternium-15	NCI	Class Study; significant potential for human exposure; moderate suspicion of carcinogenicity	CSWG = Moderate CSSG = Pending
106-47-8	p-Chloroaniline	--	NCI	--	Tentatively selected for testing
89-63-4	4-Chloro-2-nitroaniline	2-Nitro-4-chloroaniline; C. I. Azoic Diazo Component 9, Base	NCI	Class Study; high suspicion of possible carcinogenicity; potential for considerable human exposure	CSWG = High CSSG = 2. 4/10 NTP = Under consideration
126-99-8	Chloroprene	2-Chloro-1,3-butadiene	OSHA	Potential for human exposure; structural interest	CSPG = Dropped because recent studies indicate it is not carcinogenic
148-65-2	Chlorothen	--	FDA	No carcinogenicity testing	NTP = Under consideration
51990-12-6	Chlorowax 40	--	EPA/NCI	--	On test at NCI
56509-64-9	Chlorowax 500C	--	EPA/NCI	--	On test at NCI
132-22-9	Chlorpheniramine	--	FDA	No carcinogenicity testing	NTP = Under consideration
50-53-3 69-09-0	Chlorpromazine (base) Chlorpromazine (HCl)	--	NCI	--	Selected for testing
37337-13-6	Chromated copper arsenate	--	FDA/NCI	Class Study; significant potential for human exposure; reported carcinogenicity of arsenic in man	CSWG = Moderate CSSG = 1. 0/10 NTP = Under consideration

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
12336-95-7	Chromic sulfate, basic	Chromium hydroxide sulfate	NCI	Class Study; potential for considerable human exposure; trivalent compound produced local tumors in rats	CSWG = Rejected because similar to chromium (III) oxide
--	Chromium (hexavalent)	--	NIOSH	Potential human carcinogen; Industrial exposure	NTP = Dropped because not specific enough
6459-94-5	C. I. Acid Red 114	C. I. 23635; Milling Fast Red SWB; Supernylite Scarlet B; Tertracid Milling Red B	NIOSH	Derived from known carcinogen; no test data; potential for human exposure	CSWG = High CSSG = Pending
2610-05-1	C. I. Direct Blue 1	C. I. 24410; Calcomin Sky Blue 6BX; Fenamin Sky Blue 3F; Atlantic Sky Blue 6B	NIOSH	Derived from known carcinogen; no test data; potential high human exposure	CSWG = High CSSG = Pending
2429-73-4	C. I. Direct Blue 2	C. I. 22590; Diazo Black BH; Fenamin Navy Blue H, Phenazo Black BH	NIOSH	Derived from known carcinogen; potential for considerable human exposure; no adequate test data	CSWG = High CSSG = Pending
28407-37-6	C. I. Direct Blue 218	--	NCI	Class Study; potential for considerable human exposure; high suspicio of potential carcinogenicity	CSWG = High CSSG = 7. 3/10 NTP = Under consideratio
2429-82-5	C. I. Direct Brown 2	C. I. 22311; Direct Brown M; Fenamin Brown M; Phenamine Brown MB	NIOSH	Derived from known carcinogen; potential high human exposure; inadequate test data	CSWG = Rejected because structurally similar to already selected compounds

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
3626-28-6	C. I. Direct Green 1	C. I. 30280; Direct Dark Green WS; Fenamin Green M; Phenamine Dark Green B	NIOSH	Structurally related to known carcinogen; potential for considerable human exposure	CSWG = Rejected because structurally similar to known carcinogen
1325-37-7	C. I. Direct Yellow II	--	NCI	Class Study; potential for considerable human exposure; moderate suspicion of carcinogenicity	CSWG = Rejected because of lack of suspicion of carcinogen
470-57-7	Cineol (1, 8; 104)	--	FDA/NCI	Large exposure	Selected for testing
104-55-2	Cinnamaldehyde	--	FDA/OSHA/ NCI	Large exposure	Selected for testing
3468-63-1	C. I. Pigment Orange 5	1-((2, 4-Dinitrophenyl) azo)-2-naphthalenol; dinitroaniline orange	NCI	Class Study; potential for considerable human exposure; high suspicion of possible carcinogenicity	CSWG = Rejected because already being tested
2425-85-6	C. I. Pigment Red 2	Fast Red A; 1-((4-methyl-2-nitrophenyl) azo)-2-naphthalenol; ADC Toluidine Red B; Segnale Light Red B	NCI	Class Study; high suspicion of possible carcinogenicity; potential for considerable human exposure	CSWG = Moderate CSSG = 6. 0/10 NTP = Under consideration
6471-49-4	C. I. Pigment Red 23	3-(Hydroxy-4-(2-methoxy-5-nitrophenyl)-azo) -N-(3-nitrophenyl)-2-naphthalenecarboxamide	NCI	Class Study; high suspicion of possible carcinogenic activity; reductive cleavage of azo linkage would yield compound related to proven carcinogens; potential for considerable human exposure	CSWG = High CSSG = 5. 0/10 NTP = Under consideration

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
6358-31-2	C. I. Pigment Yellow 74	2-(2-Methoxy-4-nitrophenyl)azo)-N-(2-methoxyphenyl)-2-oxo butanamide	NCI	Class Study; potential for considerable human exposure; high suspicion of possible carcinogenic activity because reductive cleavage of azo linkage would yield compound related to proven carcinogen	CSWG = Low CSSG = 4. 3/10 NTP = Under consideration
5392-40-5	Citral	3, 7-Dimethyl-2, 6-octadienal	NCI	Class Study; potential for human exposure; representative - substituted vinyl aldehyde	CSWG = Moderate CSSG = 3. 2/10 NTP = Under consideration
7440-48-4	Cobalt	--	NCI	Class Study; high suspicion of potential carcinogenic activity; potential for considerable human exposure	CSWG = Moderate CSSG = 6. 2/10 NTP = Under consideration
21041-93-0	Cobalt hydroxide	Cobaltous hydroxide cobalt hydrate	NCI	Class Study; high suspicion of carcinogenicity; potential for considerable human exposure	CSWG = Rejected because it is too insoluble and one cobalt compound in the +2 oxidation state already selected
7785-24-2	Cobaltous arsenate	--	FDA	Potential large exposure due to presence in feed and environment; chemical form of arsenic in tissues unknown	Executive Summary being prepared

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
10124-43-3	Cobalt sulfate	--	NCI	Class Study; high suspicion of potential carcinogenic activity; potential for human exposure	CSWG = Moderate CSSG = 5.0/10 NTP = Under consideration
8001-30-7	Corn oil	--	FDA	Potential exposure; definite carcinogenic studies lacking	NTP = Dropped because dropped by FDA
91-64-5	Coumarin	--	FDA	Structure relationship; species specificity	NTP = Dropped because banned
4170-30-3	Crotonaldehyde	2-Butenal	NCI	Class Study; structural considerations; suspicion of carcinogenicity	CSWG = Moderate CSSG = 5.2/10 NTP = Under consideration
1299-88-3	Cupric acetoarsenite	--	FDA	Potential large exposure due to presence in feed and environment; chemical form of arsenic in tissues unknown	Executive Summary being prepared
458-37-7	Curcumin	--	FDA	Wide exposure; potential mutagen	Acted upon by NTP
110-82-7	Cyclohexane	Hexahydrobenzene; hexanaphthene	NCI	Identified as occurring in water; potential for considerable human exposure	CSWG = Rejected because of lack of suspicion of carcinogenicity
108-94-1	Cyclohexanone	--	EPA/NCI	--	On test at NCI
7336-20-1	4, 4'-Diamino-2, 2'-stilbenedisulfonic acid	--	EPA	Large production; wide exposure; lack of data	Acted upon by NTP

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
7784-44-3	Diammonium arsenate	--	FDA	Potential large exposure due to presence in feed and environment; chemical form of arsenic in tissues unknown	Executive Summary being prepared
96-13-9	2,3-Dibromo-1-propanol	--	NCI	Large production/ exposure	On test at NCI
--	2,2'-Di(sec-butoxy)acetophenone	--	NCI	Skin painting study produced carcinogenic effect in mice	CSWG = Rejected because compound not commercially significant; little exposure; structurally related compound selected for test by NCI
106-46-7	1,4-Dichlorobenzene	--	EPA/CPSC/ NCI	--	On test at NCI
15663-27-1	cis-Dichlorodiamine platinum (II)	--	NCI	Clinical trial - anti-cancer drug	Dropped by NTP because already selected for test
118-52-5	1,3-Dichloro-5,5-dimethylhydantoin	Halane	NCI	Previous NCI bioassay considered inadequate; testing by gavage requested	CSWG = Mod/high CSSG = Pending
75-35-4	1,1-Dichloroethylene	--	CPSC	--	Dropped because low production and exposure
156-59-2	cis-1,2-Dichloroethylene	--	NCI	--	Tested by NCI
156-60-5	trans-1,2-Dichloroethylene	--	OSHA	--	Tested by NCI
78-87-5	Dichloropropane	--	NCI	Recommended after review of organo chloride class	Dropped; under test

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
62-73-7	Dichlorvos	--	OSHA/NCI	--	On retest - NCI
105-58-8	Diethyl carbonate	Ethyl carbonate	EPA/NCI	Found as contaminant in chloroform; previous positive tests may have resulted from impurities	CSWG = Low/Mod CSSG = 1.2/10 NTP = Under consideration
117-81-7	Di(2-ethylhexyl)phthalate	--	EPA/FDA/ OSHA	--	NCI test completed
84-66-2	Diethyl phthalate	--	EPA	Chemical identified in drinking water	Dropped; on EPA (ITC) testing list
119-84-6	3,4-Dihydrocoumarin	--	NCI	--	Tentatively scheduled for testing
147-47-7	1,2-Dihydro-2,2,4-trimethylquinoline	--	NCI	Class Study; moderate suspicion of carcinogenicity; potential for human exposure	CSWG = Moderate CSSG = Deferred
81-55-0	1,8-Dihydroxy-4,5-dinitroanthraquinone	4,5-Dinitrochrysazin	NCI	Class Study; moderate suspicion of carcinogenic activity; potentia for considerable human exposure	CSWG = Moderate CSSG = 5.2/10 NTP = Under consideration
523-87-5	Dimenhydrinate	--	FDA	No carcinogenicity testing	NTP = Under consideration
828-00-2	Dimethoxane ("dioxin")	--	NCI	--	Tentatively selected for testing
91-93-0	3,3'-Dimethoxybenzidine	--	EPA	Carcinogen in rats; Species specificity	Dropped because of limited exposure/carcinogen in rats

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CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
121-69-7	N, N-Dimethylaniline	--	FDA/NCI	--	On test at NCI
793-24-8	N-(1, 3-Dimethylbutyl)-N'-phenyl-p-phenylenediamine	Sanoflex 13^{R}	NCI	Class Study; high suspicion of carcinogenicity based on known carcinogenic phenylenediamines; potential for human exposure	CSWG = High/low CSSG = 4. 1/10 NTP = Under consideration
68-12-2	N, N-Dimethylformamide	Dimethylformamide DMF; DMFA; N-formyldimethylamine	NCI	Present in water; potential for human exposure	CSWG = Mod/High CSSG = 3. 0/10 NTP = Under consideration
1854-26-8	Dimethyloldihydroxyethyleneurea	4, 5-dihydroxy-1, 3-bis (hydroxy-methyl)-2-imidazolidinone; dimethylolglyoxalurea; DMDHEU	NCI	Class Study; low/mod. suspicion of carcinogenicity based on potential of N-nitrosation; potential for human exposure	CSWG = Moderate CSSG = 3. 0/10 NTP = Under consideration
67-68-5	Dimethyl sulfoxide	--	TSCA	Heavy industrial exposure	Dropped; limited exposure
97-02-9	2, 4-Dinitroaniline	2, 4-Dinitrobenzenamine	NCI	Class Study; high suspicion of carcinogenicity; potential for considerable human exposure	CSWG = Moderate CSSG = 3. 3/10 NTP = Under consideration
128-42-7	4, 4'-Dinitro-2, 2'-stilbenedisulfonic acid	--	NCI	Class Study; potential for considerable human exposure; moderate suspicion of possible carcinogenic activity	CSWG = Rejected because it contained the sulfonic acid functionality and is readily excreted
147-24-0	Diphenhydramine hydrochloride	--	NCI	--	On test at NCI

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
101-84-8	Diphenyl ether	Diphenyl oxide; phenyl ether	NCI	Class Study; estimated potential for significant human exposure; model compound for carcinogenicity testing	CSWG = Deferred
102-06-7	1,3-Diphenylguanidine	DPG; Melaniline	NCI	Class Study; moderate suspicion of carcinogenicity; model compd	CSWG = Moderate CSSG = Deferred
94-92-8	N,N'-di-o-tolylethylenediamine	--	NCI	Class Study; moderate suspicion of carcinogenicity	CSPG = Dropped because of small production; compounds with similar structure already selected
25377-73-5	Dodecenylsuccinic anhydride	DDSA	NCI	Class Study; low suspicion of carcinogenicity; potential for considerable human exposure	CSWG = Low/mod CSSG = Pending
112-55-0	n-Dodecylmercaptan	1-Dodecanethiol	NCI	Class Study; unknown suspicion; usage increasing; potential for human exposure	CSWG = Moderate CSSG = 1.1/10 NTP = Under consideration
469-21-6	Doxylamine	--	FDA	No carcinogenicity testing	NTP = Under consideration
137-09-7	2,4-Draminophenol HCl	--	NIOSH	Potential carcinogen	Dropped; low exposure; tests negative
55-31-2	Epinephrine hydrochloride	--	FDA/NCI	Lack of toxicological data; devise meaningful tests	Tentatively selected for testing
106-88-7	1,2-Epoxybutane	--	EPA/OSHA/ CPSC/NCI	--	Tentatively selected for testing

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140-67-0	Estragole	Methyl chavicol; p-allylanisole	FDA/NCI	Class Study; high suspicion of probably carcinogenic activity based on structural resemblance to known carcinogen; potential for human exposure	CSWG = High CSSG = 3.1/10 NTP = Under consideration
64-17-5	Ethanol	--	NCI	--	Acted upon by NTP
100-41-4	Ethyl benzene	--	NIOSH/NCI	Large production	Selected for testing
74-96-4	Ethyl bromide	--	OSHA/NCI	--	Tentatively scheduled for testing
75-00-3	Ethyl chloride	--	OSHA/NCI	--	Tentatively scheduled for testing
107-15-3	Ethylenediamine	--	EPA	Chemically related to hydrazines, a group containing known carcinogens	Acted upon by NTP
107-21-1	Ethylene glycol	--	FDA/NCI	--	Tentatively scheduled for testing
75-21-8	Ethylene oxide	--	OSHA/EPA/ NCI	--	Tentatively scheduled for testing
110-80-5	2-Ethoxyethanol	--	OSHA/NIOSH	Large production/ exposure	Acted upon by NTP
37381-81-0	Ferromanganese	--	NCI	Class Study; significant potential for human exposure; reported carcinogenicity of manganese chloride	CSWG = Moderate CSSG = Deferred

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
11108-70-6	Ferroselenium	Selenium alloy, base	NIOSH/NCI	Class Study; need for chronic toxicity data (NIOSH) for criteria document on selenium; high susp. of carcinogen	CSWG = High CSSG = 3.1/10 NTP = Under consideration
50-00-0	Formaldehyde	--	OSHA/CPSC/ NIEHS/NCI	--	Considered but dropped; on test at CIIT
110-00-9	Furan	--	NCI	--	Selected for testing
98-00-0	Furfuryl alcohol	--	NCI	--	Tentatively selected for testing
54-31-9	Furosemide	--	NCI	--	On test at NCI
111-30-8	Gluteraldehyde	--	OSHA/EPA/ NCI	Large exposure	On test at NCI
2238-07-5	Glycidyl ethers (allyl)	--	EPA/OSHA/ NIOSH	Lack of specific toxicity tests; sizeable exposure	Acted upon by NTP
9005-65-6	Glycol (Polysorbate 80)	--	CPSC/NIOSH	Wide industrial exposure; oxalic acid formation	Acted upon by NTP
52551-67-4	HC Yellow No. 4	--	NCI	--	Selected for testing
517-28-2	Hematoxlin	--	OSHA/NCI	--	On test at NCI
59080-40-9	Hexabromobiphenyl	--	NCI	Persistance-body-burden-low level exposure from farm products	Acted upon by NTP
87683-12-4	Hexachlorobutadiene	--	NCI	Chemical identified in drinking water	Dropped; not in production

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
77-47-4	Hexachlorocyclopentadiene	--	NCI	--	Selected for testing
67-72-1	Hexachloroethane	--	EPA/NIOSH	Potential carcinogen; industrial exposure	Acted upon by NTP
684-16-2	Hexafluoroacetone	--	NCI	--	On test at NCI as trihydrate
4719-04-4	Hexahydro-1, 3, 5-tris-(2-hydroxyethyl) triazine	1, 3, 5-Triazine-1, 3, 5-(2H, 4H, 6H)-triethanol; Grotan B; Onyxide 200	NCI	Class Study; considerabl potential for human exposure; unknown suspicion of carcinogenicity	CSWG = Rejected because of lack of data and lack of suspicion of carcinogenicity
548-62-9	Hexamethyl-p-rosaniline chloride	--	FDA/NCI	Potential large exposure through tissue residues; for regulatory purposes	Selected for testing
110-54-3	n-Hexane	--	CPSC	Wide exposure; complet toxicology profile shoul be developed	Acted upon by NTP
58-93-5	Hydrochlorothiazine	--	NCI	--	On test at NCI
123-31-9	Hydroquinone	--	OSHA/NCI/EPA	--	On test at NCI
103-90-2	Hydroxyacetanilide	--	NCI	--	Selected for testing
131-57-7	2-Hydroxy-4-methoxybenzophenone	Uvinul M-40^R; oxybenzone	NCI	Class Study; exposure; gap in structure/activity data; unknown suspicion of carcinogenicity; potential for considerable human exposure	CSWG = Moderate CSSG = 3. 4/10 NTP = Under consideration
121-19-7	4-Hydroxy-3-nitrophenylarsonic acid	--	FDA	Potential large exposure due to presence in feed and environment; chemical form of arsenic in	Executive Summary being prepared

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
121-19-7	4-Hydroxy-3-nitrophenylarsonic acid (CONT'D)			tissues unknown; may present health effects	
56-69-9	5-Hydroxytryptophan	--	FDA	Wide exposure; need to develop protocols	Acted upon by NTP
53-86-1	Indomethacine	--	NCI	--	Selected for testing
1308-31-2	Iron chromite	Chromite	NCI	Class Study; high annual consumption (potential high exposure) and lack of adequate test data	CSWG = High CSSG = Pending
78-84-2	Isobutyraldehyde	2-Methylpropanal	FDA/NCI	Class Study; representative branched alkyl aldehyde; high potential for human exposure; occurrence in water	CSWG = Low CSSG = 2.2/10 NTP = Under consideration
97-54-1	Isoeugenol	2-Methoxy-4-propenylphenol; 4-propenylguaiacol	NCI	Class Study; moderate suspicion of carcinogenicity due to relationship to known carcinogen; potential for considerable human exposure	CSWG = Low/Mod CSSG = 4.3/10 NTP = Under consideration
78-79-1	Isophorone	--	OSHA/NCI/EPA	--	On test at NCI
114-26-1	2-Isopropoxyphenyl N-methylcarbamate	2-(1-Methylethoxy)-phenol methylcarbamate; Baygon; propoxur	NCI	Class Study; potential for high human exposure; gap in knowledge	Still under consideration

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
101-72-4	N-Isopropyl-N--phenyl-p-phenylenediamine	para-Isopropylaminodiphenylamine; Santoflex IP^R	NCI	Class Study; high suspicion of carcinogenic activity; high potential for exposure	CSWG = High/Low CSSG = 4. 2/10 NTP = Under consideration
51-30-9	Isoproterenol HCl	--	NCI	--	Selected for testing
7439-92-1	Lead (metal)	--	NCI	Class Study; high suspicion of potential carcinogenicity; potential for considerable human exposure	CSWG = Rejected because already accepted as a carcinogen
1309-60-0	Lead dioxide	Lead brown; lead peroxide	NCI	Class Study; potential for considerable human exposure; high suspicion of potential carcinogenicity	CSWG = Rejected because already accepted as a carcinogen
1317-36-8	Lead monoxide	C. I. Pigment Yellow 46; litharge; plumbous oxide	NCI	Class Study; significant potential for human exposure; high suspicion of potential carcinogenicity	CSWG = Rejected because already accepted as a carcinogen
1309-60-0	Lead oxide	--	OSHA	Wide exposure to lead/lead salts suspected to be animal carcinogen	Dropped; to be phased out
128-86-3	d-Limonene	--	OSHA/CPSC/NCI/FDA	--	On test at NCI
554-13-2	Lithium carbonate	Dilithium carbonate; Eskalith; Lithane	NCI	Class Study; potential for considerable human exposure	CSWG = Rejected because of lack of suspicion; negative animal study

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
1309-42-8	Magnesium hydroxide	Magnesium hydrate	NCI	Class Study; potential for human exposure; gap in knowledge	CSWG = Moderate CSSG = Pending
1313-13-9	Manganese dioxide	C. I. 77728; manganese black; manganese peroxide	NCI	Class Study; significant potential for human exposure; suspicion of potential carcinogenicity	CSWG = Moderate CSSG = Deferred
1344-43-0	Manganese oxide	C. I. 77726; Cassel Green; Manganese Green; manganese monoxide; manganous oxide; Rosenstiehl Green	NCI	Class Study; significant potential for human exposure; high suspicion of carcinogenicity based on reported carcinogenicity of manganese chloride	CSWG = Low/Mod CSSG = Deferred
7785-87-7 10124-55-7	Manganese sulfate	---	NCI	Class Study; significant potential for human exposure; high suspicion of carcinogenicity of manganese chloride	CSWG = High CSSG = 4.3/10 NTP = Under consideration
583-39-1	2-Mercaptobenzimidazole	2-Benzimidazolethiol	NCI	Class Study; significant potential for human exposure; unknown suspicion of carcinogenicity	CSWG = High CSSG = 6.0/10 NTP = Under consideration
149-30-4	2-Mercaptobenzothiazole	--	NCI	Potential wide exposure; (medicinal solution capped with rubber stopper containing compound)	Acted upon by NTP
7487-94-7	Mercuric chloride	--	NCI/FDA	Metal class study	Tentatively selected for testing

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
7439-97-6	Mercury (metal)	--	OSHA/NCI	Wide use; Class Study; spindle cell sarcomas found in rats following intraperitoneal administration; evaluation of its toxic potential needed	CSWG = Rejected because of lack of evidence for carcinogenicity proposed epidemiology study NTP = acted upon
91-80-5	Methapyriline	--	FDA	Widespread use as sleeping aid; inadequate previous test	Dropped; banned
1982-37-2	Methadilazine	--	FDA	No carcinogenicity testing	Under consideration
298-81-7	8-Methoxypsoralin	--	NCI	--	On test at NCI
74-87-3	Methyl chloride	--	OSHA/EPA	--	On test at CIIT
92-48-8	Methyl coumarin	--	NCI	--	Selected for testing
6317-18-6	Methylene bis(thiocyanate)	Methylenedirhodanide; methylene thiocyanate	NCI	Class Study; unknown suspicion of carcinogenicity; potential for significant human exposure	CSWG = Deferred
75-09-2	Methylene chloride	--	EPA/NCI	--	Tentatively selected for testing
93-15-2	Methyleugenol	4-Allylveratrole; eugenyl methyl ether	NCI	Class Study; moderate suspicion of carcinogenic activity because of structural resemblance to known carcinogen; potential for considerable human exposure	CSWG = Moderate CSSG = 7.0/10 NTP = Under consideration

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
421-20-5	Methyl fluorosulfonate	Magic methyl	Dr. James Cummins	One of three major methylating agents used by organic chemists; volatile; potential carcinogen	CSWG = Very high (for testing in lung adenom assay in Strain A mice) CSSG = Pending
67-62-9	o-Methylhydroxylamine	--	EPA	Mutagen in in vitro system; potential carcinogen	Dropped; low production and exposure
80-62-6	Methyl methacrylate	--	NCI	Considerable potential for human exposure and carcinogenic activity	CSPG = Dropped because results of recent study were negative
924-42-5	N-Methylolacrylamide	N-(Hydroxymethyl)-2-propenamide; N-methanol-acrylamide; N-(hydroxymethyl)acrylamide	NCI	Class Study; moderate suspicion based on structural relationship to known carcinogen; potential for nitrosation; considerable potential for exposure	CSWG = Moderate CSSG = 3.0/10 NTP = Under consideration
113-45-1 298-59-9	Methylphenidate	Ritalin^{R}; alpha-phenyl-2-piperidine-acetic acid methyl ester	NCI/FDA	Class Study; significant levels of estimated exposure; chronic use in children; lack of data	CSWG = High CSSG = 5.2/10 NTP = Under consideration
333-27-7	Methyl trifluoromethanesulfonate	Methyl triflate	Dr. James Cummins	One of three major methylating agents used by organic chemists; volatile	CSWG = High CSSG = Pending (for testing in lung adenom assay in Strain A mice)
107-25-5	Methyl vinyl ether	Methoxyethylene; vinyl methyl ether	NCI	Class Study; moderate suspicion of carcinogenicity; commercially important	CSWG = Rejected because of limited exposure

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
1313-27-5	Molybdenum trioxide	Molybdic oxide	NCI	Class Study; largest production of all molybdenum compounds; significant potential for human exposure	CSWG = Moderate CSSG = Pending
79-11-8	Monochloroacetic acid	--	EPA	High toxicity in animals indicated potential hazard to humans	Acted upon by NTP
2163-80-6	Monosodium methane arsenate	--	EPA	Structure activity between organic and inorganic arsenicals; animal model needed	Acted upon by NTP
389-08-2	Nalidixic acid	--	NIOSH/NCI	--	On test at NCI
91-20-3	Naphthalene	--	NIOSH/NCI	--	On test at NCI
--	Navy fuels JP-5	--	NCI	--	On test at NCI
20702-77-6	Neohesperidin dihydrochalcone	--	Nutrilite Products, Inc. / USDA	Potential use as a low calorie sweetener; potential high exposure	CSWG = High CSSG = 6. 1/10 NTP = Under consideration
7440-02-0	Nickel	--	Dr. Mastromatteo (INCO)	Class Study; epidemiological and animal data; potential needs to be resolved	CSWG = Rejected because previous study showed injection site sarcomas
7718-54-9	Nickel chloride	Nickelous chloride; nickel dichloride; nickel chloride hexahydrate	NCI	Class Study; reported carcinogenicity of other nickel-containing inorganics; significant potential for human exposure	CSWG = Rejected because nickel (II) sulfate is already selected

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
13138-45-9 14216-75-2	Nickel nitrate	Nickelous nitrate; nickel dinitrate	NCI	Class Study; reported carcinogenicity of other nickel-containing inorganics; significant potential for human exposure	CSWG = Rejected because nickel (II) sulfate is already selected
1313-99-1	Nickel oxide	Nickel monoxide; nickelous oxide	Dr. Mastromatteo (INCO)	Class Study; epidemiological and uncertain animal data	CSWG = High CSSG = Pending
7786-81-4	Nickel sulfate	Nickelous sulfate	NCI	Class Study; significant potential for human exposure; reported carcinogenicity of other nickel containing inorganics	CSWG = Moderate CSSG = 8. 1/10 NTP = Under consideration
100-01-6	p-Nitroaniline	1-Amino-4-nitrobenzene; Azoic Diazo Component 37	NCI	Class Study; high suspicion of possible carcinogenicity; potential for considerable human exposure	CSWG = Moderate CSSG = 5. 0/10 NTP = Under consideration
91-23-6	o-Nitroanisole	2-Methoxynitrobenzene	NCI	Class Study; high suspicion of carcinogenic activity because it is a nitro analog of known carcinogen; potential for considerable human exposure	CSWG = Moderate CSSG = 2. 4/10 NTP = Under consideration
98-95-3	Nitrobenzene	Nitrobenzol; oil of mirbane	NIOSH/NCI	Class Study; moderate suspicion of carcinogenicity; potential for considerable human exposure	CSWG = High CSSG = 7. 1/10 NTP = Under consideration
698-63-5	5-Nitro-2-furaldehyde	--	NCI	Academic interest;	Acted upon by NTP

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
698-63-5	5-Nitro-2-furaldehyde (CONT'D)			Metabolite of nitrofurans	
59-87-0	Nitrofurazone	--	NCI	--	On test at NCI
646-14-0	Nitrohexane	--	NCI	Potential for human exposure	CSPG = Dropped because study being done at LSU
100-02-7	p-Nitrophenol	--	OSHA/NCI	Large production/ exposure; potential carcinogen	Tentatively selected for testing
3025-77-2	1-((4-Nitrophenyl)azo)-2-naphthalenamine	1-((p-Nitrophenyl)azo)-2-naphthylamine; 1-(4'-nitrophenylazo)-2-naphthylamine; C. I. Solvent Red 5; B-1 Dye	Department of Defense	Present and past high usage and widespread exposure	CSWG = Moderate CSSG = 2. 3/10
1116-54-7	N-Nitrosodiethanolamine	--	FDA	--	Selected for testing
1321-12-6	Nitrotoluene	--	NIOSH	Wide occurrence/ exposure; potential carcinogen	Acted upon by NTP
124-19-6	Nonanal	n-Nonyl aldehyde; Pelargonic aldehyde	NCI	Class Study; representative long-chain aliphatic aldehyde; relatively high potential for exposure	CSWG = Moderate CSSG = 2. 2/10 NTP = Under consideration
303-47-9	Ochratoxin A	--	FDA	Potential wide exposure; potential carcinogen	Acted upon by NTP
3268-87-9	Octachlorobenzodioxin (Category #1 only)	--	FDA/NIEHS	Potential wide exposure; occurs in environment; carcinogenicity of this class of compounds could not be evaluated by IARC from available data	Acted upon by NTP

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
607-910	Oil of nutmeg	--	FDA/NCI	Large exposure	Acted upon by NTP
112-62-9	Oleic acid, methyl ester, cis	--	OSHA/NIOSH	Potential carcinogen; potential high exposure	Dropped; low exposure
--	Organophosphates	--	FDA	Large production; large potential human exposure	Dropped; not specific enough
144-62-7	Oxalic acid	--	NIOSH/OSHA/ NCI	--	On test at NCI
79-57-2	Oxytetracycline	--	NCI	--	On test at NCI
7647-10-1	Palladium (2+) chloride	--	OSHA	Potential environmental pollutant; lack of toxicology data	Acted upon by NTP
61-25-6	Papaverine hydrochloride	1-(3,4-Dimethoxybenzyl) - 6,7 -dimethoxyisoquinoline hydrochloride; Pavabid^{R}	FDA/NCI	Class Study; chronic use and large estimated level of exposure; lack of carcinogenicity data; presence of isoquinoline moiety in structure	CSWG = Moderate CSSG = 3.2/10 NTP = Under consideration
1825-21-4	Pentachloroanisole	--	FDA/NCI	Potential high exposure to low levels from fish and finished water	Chronic study to be done
76-01-7	Pentachloroethane	--	NCI	--	On test at NCI
82-68-8	Pentachloronitrobenzene	--	NCI	--	Tested by NCI and tentatively selected for retest
78-11-5	Pentaerithritol tetranitrate	--	NCI	--	Tentatively selected for testing

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
127-18-4	Perchloroethylene	--	CPSC	Large production; wide exposure; potential carcinogen	Acted upon by NTP
--	Petroleum distillates	--	EPA	Large production; lack of long term toxicity data; use as pesticide vehicles	Dropped; low exposure and not specific enough
86-21-5	Pheniramine	--	FDA	No carcinogenicity testing	Under consideration by NTP
108-95-1	Phenol	--	FDA/NCI	--	Tested by NCI; report drafted
977-09-8	Phenolphthalein	--	OSHA/NCI	--	On test at NCI
1333-39-7	Phenolsulfonic acid	--	NIOSH (Dr. Gregory)	Potential human exposure	CSPG = Dropped because compound is rapidly excreted and not expected to be toxic
97-18-7	Phenol, 3,3'-thiobis	--	FDA	Wide exposure; lack of toxicology data	Acted upon by NTP
673-06-3	D-Phenylalanine	--	FDA	Needed to develop research protocols	Acted upon by NTP
1006-51-2	N-Phenylhydroxylamine	--	OSHA/NIOSH	Carcinogen bioassay inadequate	Dropped; low production/ exposure
62-38-4	Phenyl mercuric acetate	--	EPA	Structure activity studies needed; potential mutagen	Dropped; not in use
57-41-0	Phenytoin	--	NIEHS/NCI	Large production/ exposure; inadequate carcinogenicity data; used as an anti-convulsant	Dropped; adequately tested

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
75-44-5	Phosgene	--	EPA	Occurs in environment; data on extremely low level inhalation	Tentatively selected for testing
1918-02-1	Picloram	--	NCI	--	Tested by NCI; selected for retest
110-89-4	Piperidine	Hexahydropyridine; hexazane; pentamethylenimine	NCI	Identified as occurring in water; potential for human exposure	CSWG = Rejected because of negative evidence from two studies
9003-39-8	Polyvinylpyrrolidone polymers	--	CPSC/FDA OSHA	Potential wide human exposure	Acted upon by NTP
15322-68-3	Polyethylene glycol-200	PEG-200; Carbowax; polyethylene oxide; -hydro- -hydroxypoly-(oxy-1,2-ethanediyl)	DOD	Previous animal carcinogenicity tests interpreted to indicate potential carcinogenic activity	CSWG = Rejected because recent studes indicated compound was not carcinogenic
9009-54-5	Polyurethane	--	FDA	Large production/ exposure	Acted upon by NTP
9002-86-2	Polyvinyl chloride latex	PVC latex	NCI	Class Study; unknown suspicion of carcinogenicity; potential for considerable human exposure	CSWG = Mod/High CSSG = 3.2/10 NTP = Under consideration
20762-60-1	Potassium azide	--	EPA	Potential wide exposure/ nucleophilic agent; needs retesting	Acted upon by NTP
7778-50-9	Potassium dichromate	--	NCI	Class Study; potential for human exposure; moderate suspicion of carcinogenicity	CSWG = Rejected because representative chromium (VI) compound already selected

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
125-33-7	Primaclone	Primidone; Mysoline^R; 5-ethyl-5-phenyl-hexahydro-pyrimidine-4, 6-dione	FDA/NCI	Class Study; large estimated exposure; widespread	CSWG = High CSSG = 3. 1/10 NTP = Under consideration
57-66-9	Probenecid	--	NCI	--	Tentatively selected for testing
60-87-7	Promethazine	--	FDA	No carcinogenicity testing	Under consideration
50-34-0	Propantheline bromide	β-Diisopropyl-amino-ethyl xanthene-9-carboxylate methobromide; Pro-Banthine^R	FDA/NCI	Class Study; chronic use and large estimated level of exposure; lack of carcinogenicity data	CSWG = High CSSG = 6. 0/10 NTP = Under consideration
123-38-6	Propionaldehyde	Propanal	NCI	Class Study; high potential for human exposure; high suspicion of carcinogenicity	CSWG = Moderate CSSG = 2. 2/10 NTP = Under consideration
91-84-9	Pyrilamine	--	FDA	No carcinogenicity testing	Under consideration
117-39-5	Quercetin	--	FDA	Wide exposure/potential mutagen	Acted upon by NTP
56-54-2	Quinidine	6'-Methoxy-cinchonan-9-ol; beta-quinine	FDA/NCI	Class Study; interest of FDA; lack of carcinogenicity	CSWG = High CSSG = 6. 1/10 NTP = Under consideration
804-63-7	Quinine sulfate	--	NCI	Potential for human exposure; structural interest	CSPG = Dropped because recent test indicated negative results

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
106-51-4	p-Quinone	--	NCI	--	Tentatively selected for testing
108-46-3	Resorcinol	--	CPSC	Occurs in environment and ground water; potential large exposure	Acted upon by NTP
483-65-8	Retene	--	NCI	--	Dropped; lack of knowledge of occurrence/exposure/ availability of compounds
989-38-8	Rhodamine 6G	--	EPA/NCI	--	On test at NCI
23246-96-0	Riddelliine	--	FDA	Potential wide exposure; potential carcinogen	Acted upon by NTP
599-79-1	Salicylazosulfapyridine	Azulfidine; sulfasalazine	NCI	Class Study; low suspicion of possible carcinogenicity; potential for considerable human exposure	CSWG = High CSSG = Pending
7782-49-2	Selenium	C. I. 77805	NIOSH/NCI	Class Study; high suspicion of selenium compounds in general; potential for considerable human exposure; lack of toxicology data (inhalation)	CSWG = High CSSG = 2. 2/10 NTP = Under consideration
480-81-9	Seneciphylline	--	FDA	Potential wide exposure; potential carcinogen	Acted upon by NTP
7761-88-8	Silver nitrate	Silver mononitrate	NCI	Class Study; representative soluble silver salt; considerable potential for human exposure	CSWG = Rejected because of limited exposure

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
1344-00-9	Sodium aluminosilicate	--	FDA/NCI/ OSHA	--	On test at NCI
127-85-5	Sodium arsanilate	--	FDA	Potential large exposure due to presence in feed and environment; chemical form of arsenic in tissues unknown; may present health effects	Executive summary being prepared
26628-22-8	Sodium azide	--	EPA	Potential wide exposure/ nucleophilic agent; needs retesting	Acted upon by NTP
7775-11-3	Sodium chromate	--	NCI	Class Study; potential for considerable human exposure; high suspicion of chromates in general	CSWG = Moderate CSSG = 3. 3/10 NTP = Under consideration
2893-78-9	Sodium dichloroisocyanurate	--	OSHA/NCI	--	Selected for testing
10102-18-8	Sodium selenite	Disodium selenite	NCI	Class Study; high suspicion of selenium compounds in general; potential for human exposure	CSWG = Moderate CSSG = 3. 1/10 NTP = Under consideration
15242-96-3	Stearatochromic chloride complex	Quilon^R; hydroxystearato dichromium chloride; stearylated chromium complex	NCI	Class Study; unknown carcinogenicity; considerable potential for human exposure	CSWG = Moderate CSSG = 1. 3/10 NTP = Under consideration
1633-05-02	Strontium carbonate	Strontianite	NCI	Class Study; CSWG requested nomination of strontium compound with highest exposure and non-suspicious anion	CSWG = Moderate CSSG = Pending

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
7789-06-2	Strontium chromate	--	NCI	Class Study; potential for considerable human exposure; high suspicion of chromates in general	CSWG = Rejected because potential carcinogenicity of strontium is unknown
100-42-5	Styrene	--	FDA	--	Tested by NCI
57-50-1	Sucrose	--	FDA/NCI	Large production/ exposure	Tentatively selected for testing
57-68-1	Sulfamethazine	4,6-Dimethyl-2-sulfanilamidopyrimidine; sulfadimidine	NCI	Class Study; low suspicion of carcinogenicity; potential for considerable human exposure; potential tissue residue in swine	CSWG = Rejected because to be tested at NCTR
144-82-1	Sulfamethizole	2-(o-Aminobenzenesulfonamido-5-methylthiadiazole; Microsul; Thiosulfil	NCI	Class Study; moderate suspicion of potential carcinogenicity; considerable potential for human exposure	CSWG = High CSSG = Pending
63-74-1	Sulfanilamide	4-Aminobenzenesulfonamide; p-anilinesulfonamide	NCI	Class Study; simple model compound representative of anti-bacterial aryl sulfonamides; potential for considerable human exposure	CSWG = High CSSG = Pending
72-14-0	Sulfathiazole	4-Amino-N-2-thiazolylbenzenesulfonamide	NCI	Class Study; low suspicion of possible carcinogenicity; considerable potential for human exposure	CSWG = High CSSG = Pending

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
14807-96-6	Talc (Category #1 only)	--	FDA	--	Tested by NCI
107-35-7	L-Taurine	--	FDA	No information on chronic use available	Acted upon by NTP
13494-80-9	Tellurium	--	NIOSH	Potential carcinogen	Acted upon by NTP
1746-01-6	2, 3, 7, 8-Tetrachlorodibenzo-dioxin	--	FDA	Occurs in environment; IARC could not evaluate carcinogenicity from available data	Acted upon by NTP
51207-31-9	2, 3, 7, 8-Tetrachlorodibenzo-furan	--	NCI	Research	Tentatively selected for testing
117-08-8	Tetrachlorophthalic anhydride	Tetrathol^R	NCI	Class Study; low-moderate suspicion of carcinogenicity; considerable potential for human exposure	CSWG = Rejected because of limited use and lack of sufficient structure activity similarity to warrant suspicion of carcinogen
78-00-2	Tetraethyl lead	--	OSHA/NCI	--	Dropped; proposed to be banned
124-64-1	Tetrakis	--	CPSC	--	To be tested at NCI in 1980
1972-08-3	1-trans- Δ^9-Tetrahydrocannabinol; THC	Tetrahydrocannabinol; THC	NIDA	High exposure; THC is believed to be the active component in marijuana and also a major psychoactive component	CSWG = Moderate CSSG = 2. 0/10 NTP = Under consideration
109-99-9	Tetrahydrofuran	Diethylene oxide; THF; tetramethylene oxide	NCI/NIOSH	Medium exposure; Class Study; potential for considerable human exposure	CSWG = High CSSG = 5. 2/10 NTP = Under consideration

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
509-14-8	Tetranitromethane	--	NCI	--	Selected for testing
91-79-2	Thenyldiamine	--	FDA	No carcinogenicity testing	Under consideration
91-85-0	Thonzylamine	--	FDA	No carcinogenicity testing	Under consideration
7440-32-6	Titanium	--	NIOSH/NCI	Class Study; significant potential for human exposure; preliminary evidence of carcinogenicity in animals	CSWG = Moderate CSSG = 1. 2/10 NTP = Under consideration
1271-19-8	Titanium ferrocene	--	NIOSH	Wide exposure/carcinogen	Tentatively selected for testing
7704-98-5	Titanium hydride	--	NCI	Class Study; significant potential for human exposure; preliminary evidence of carcinogenicity for titanium metal	CSWG = Rejected because of its low exposure
13463-67-7	Titanium oxide	--	NIOSH	Wide exposure/potential carcinogen	Acted upon by NTP
59-02-9	Tocopherol	--	FDA/NCI	Wide exposure	Tentatively selected for testing by NCI
108-88-3	Toluene	--	EPA/NCI	Large production/exposure	Tentatively selected for testing

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
1576-35-8	p-Toluenesulfonyl hydrazide	Celogen TSH^R	NCI	Class Study; moderate suspicion of carcinogenicity; potential for human exposure	CSWG = Moderate CSSG = 2.2/10 NTP = Under consideration
396-01-0	Triamterene	2, 4, 7-Triamino-6-phenyl-pteridine; Dyrenium^R	FDA/NCI	Class Study; high estimated level of exposure; chronic use; lack of carcinogenicity data; suspicious structure; interest of FDA	CSWG = High CSSG = 6.2/10 NTP = Under consideration
87 61-6	1, 2, 3-Trichlorobenzene	---	FDA/EPA	Wide exposure due to use pattern/potential occurrence in drinking water	Acted upon by NTP
120 82-1	Trichlorobenzene	---	FDA	Exposure via drinking water/fish; Carcinogenicity screen needed	Acted upon by NTP
79-01-6	Trichloroethylene	---	CPSC	---	Tested by NCI; Selected for retest
115-96-8	Tri(2-chloroethyl)phosphate	Tris(beta-chloroethyl) phosphate	NCI	Class Study; representative chlorinated aliphatic phosphate	CSWG = Moderate CSSG = 2.3/10 NTP = Under consideration
7673-09-8	Trichloromelamine	N, N', N''-Trichloro-1, 3, 5-triazine-2, 4, 6-triamine; TCM	DOD	Potential for human exposure; structural interest	CSWG = Mod/high CSSG = Pending
95-95-4	2, 4, 5-Trichlorophenol	Dowicide 2	NCI	Class Study; significant potential for human exposure; moderate suspicion of carcinogenicity	CSWG = Mod/high CSSG = Pending

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
25735-29-9	1, 2, 3-Trichloropropane	---	NIOSH	Potential carcinogen; potential substitute for chlorinated solvents	Acted upon by NTP
1330-78-5	Tricresyl phosphate	Tritolyl phosphate; phosphoric acid tris (methylphenyl)ester	EPA/NCI	Class Study; representative aromatic phosphate plasticizer	CSWG = Low CSSG= 2. 3/10 NTP = Under consideration
70-00-8	Trifluorothymidine	5-Trifluoromethyl-2'-deoxyuridine; trifluorothymidine deoxyriboside; F_3TDR	Burroughs Wellcome Co.	Experimental use as antiviral and anti-tumor agent; scientific interest	CSWG = High CSSG = Pending
552-30-7	Trimellitic anhydride	---	NCI	Medium production; wide application	Selected for testing
4460-86-0	2, 4, 5-Trimethoxybenzaldehyde	Asaronaldehyde; gazarin	NCI	Structural relationship to apparent carcinogen; high potential human exposure	CSWG = Moderate CSSG = Pending (short term tests only)
54075-76-2	Trimethyloxonium hexachloroantimonate	---	Dr. James Commins	Non-volatile; one of three major methylating agents used by organic chemists	CSWG = Very high CSSG = Pending (for testing in lung adenoma assay in Strain A mice)
118-96-7	2, 4, 6-Trinitrotoluene	--	NCI	--	Tentatively selected for testing
91-81-6	Tripelenamine	---	FDA	No carcinogenicity testing	Under consideration

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
115-96-8	Tris(2-chloroethyl)phosphate	---	CPSC	---	Selected for testing
12070-12-1	Tungsten carbide	Tungsten monocarbide	NCI	Class Study; considerable potential for human exposure; representative tungsten with +4 valence	CSWG = Rejected because it i not absorbed orally; expected complication in an inhalation study
1314-62-1	Vanadium pentoxide	Vanadic anhydride	NCI	Class Study; potential for significant human exposure	CSWG = Low CSSG = Pending
106-87-6	Vinyl cyclohexene dioxide	---	NIOSH	Potential carcinogen; occupational exposure	Acted upon by NTP
75-38-7	Vinylidene fluoride	---	OSHA	Wide exposure; potential carcinogen	Tentatively selected for testin
1319-37-9	Vinyl toluene	---	NCI	--	Tentatively selected for testin
1406-16-2	Vitamin D	---	FDA	Wide exposure	Dropped; by FDA
67-92-0	Vitamin D_3	---	FDA	Wide exposure	Dropped; by FDA
1010-29-0	Wollastonite-calcium silicate	---	EPA/NCI	Medium production/exposure	Selected for testing
---	Xylenes, mixed	---	OSHA/EPA/NCI	---	On test at NCI
1300-72-7	Xylenesulfonic acid	---	OSHA	---	Selected for testing
87-62-7	2,6-Xylidine	---	NCI	---	Tentatively selected for testin
1314-13-2	Zinc oxide	C.I. Pigment White 4; zinc monoxide; zinc white	Edgewood Arsenal/NCI	Class Study; potential for significant human exposure	CSWG = Moderate CSSG = Pending
12433-50-0	Zinc potassium chromate	---	NCI	Potential for high human exposure	CSWG=Moderate CSSG = Pending

CAS NUMBER	CHEMICAL NAME	SYNONYM(S)	AGENCY REQUESTING	RATIONALE FOR REQUEST	ACTION BY DHEW
7699-43-6	Zirconium oxychloride	Zirconyl chloride	NCI	Class Study; unknown carcinogenicity; potential for human exposure	CSWG = Moderate CSSG = 4.3/10 NTP = Under consideration

Information Related to Research and Testing Relevent to Carcinogenicity of Substances

CAS Number	Chemical Name	Synonym(s)	Agency Requesting	Rationale for Request	Additional Indicators (i.e., mutagenicity, structure activity, etc.)	Action by DHEW
55-18-5	N-nitroso-diethylamine			Research in subhuman primates		
81-07-2	1, 2-benzisothiazol-3(2H)-one 1, 1-dioxide; 2, 3-dihydro-3-oxobenzisosul-fonazole;	Saccharin		Research in subhuman primates		
3223-07-2	3-(p-(bis(2-chloroethyl) amino)phenyl)-L-alanine, monohydrochloride	L-phenylalanine mustard		Research in subhuman primates		
50-29-3	1, 1' (2, 2, 2-Trichloroethylidene)bis(4-chlorobenzene); 1, 1, 1-trichloro-2, 2-bis-(p-chlorophenyl) ethane;	DDT		Research in subhuman primates		
70-25-7	1-methyl-3-nitro-1-nitrosoguanidine			Research in subhuman primates		
62-75-9	N-nitroso-dimethylamine			Research in subhuman primates		
684-93-5	1-methyl-1-nitroso-urea			Research in subhuman primates		
50-18-0	N, N-Bis(2-chloroethyl) tetrahydro 2H-1, 3, 2-oxazaphosphorin-2-amine 2-oxide;	Cyclophosphamide		Research in subhuman primates		
446-86-6	6-[(1-methyl-4-nitroimidazol-5-yl)thio]-purine monohydrate	Azathioprine Imuran		Research in subhuman primates		

CAS Number	Chemical Name	Synonym(s)	Agency Requesting	Rationale for Request	Additional Indicators (i.e., mutagenicity, structure activity, etc.)	Action by DHEW
366-70-1	N-isopropyl-α-(2-methylhydrazino)-p-toluamide, hydrochloride	Procarbazine		Research in sub-human primates		
592-62-1	(methylazoxy)-methanol acetate	MAM Acetate		Research in sub-human primates		
25316-40-9	3β-glycoloyl-1, 2, 3-4, 6, 11-hexahydro-3, 5 12-trihydroxy-10-methoxy-6, 11-dioxo-1α-naphthacenyl 3-amino-2, 3, 6-trideoxy-α-L-lyxo-hexopyranoside, hydrochloride	Adriamycin		Research in sub-human primates		
10048-13-2	3a, 12c-dihydro-8-hydroxy-6-methoxy-7H-furo (3', 2':4, 5)-furo(2, 3-c) xanthen-7-one,	Sterigmatocystin		Research in sub-human primates		
100-88-9	Cyclohexylsulfamic acid	Cyclamate		Research in sub-human primates		
1162-65-8	2, 3, 6aα, 9aα-Tetrahydro-4-methoxy-cyclopenta(c) furo-(3', 2':4, 5)furo(2, 3-h)(1)benzopyran-1, 11-dione	Aflatoxin B_1		Research in sub-human primates		

LEGEND FOR ABBREVIATIONS USED IN TABLES

GOVERNMENT AGENCIES

CPSC	Consumer Protection Agency
DOD/EA	Department of Defense, Chemical Systems Laboratory, Aberdeen Proving Ground, Maryland
DOD/EL	Department of Defense, US Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, Maryland
EPA	Environmental Protection Agency
FDA	Food and Drug Administration
NCI	National Cancer Institute
NIDA	National Institute for Drug Abuse
NIEHS	National Institute of Environmental Health Sciences
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration, Department of Labor
USDA	U.S. Department of Agriculture

UNIVERSITY

LSU	Louisiana State University

INDUSTRY

CIIT	Chemical Industry Institute of Toxicology

CHEMICAL NOMINATION GROUPS

CSWG	Chemical Selection Working Group, National Cancer Institute (NCI)
CSSG	Chemical Selection Subgroup of the Clearinghouse on Environmental Carcinogens/NCI
CSPG	Chemical Selection Planning Group of National Cancer Institute
NTP	National Toxicology Program

PRIORITIZATION SCHEME

NTP	Priority from low to medium to high
CSWG	Priority from low to medium to high
CSSG	Priority on scale of 1 to 10 (as high)

CAS Number	Chemical Name	Agency Requesting	Data Provided on Toxicity and/or Carcinogenicity
83-32-9	Acenaphthene	EPA	Toxicity
	Acenaphthene	Oakridge National Laboratory	Carcinogenicity
103-11-7	Acrylic acid, 2-ethylhexyl ester	Navy	Toxicity
	Agent Orange	VA Medical Center	Toxicity
	L-Alanyl-beta-naphthylamide	VA	Carcinogenicity
	Aliphatic poly isocyanate	Navy	Toxicity
	"Alkasteem"	Congress (Rep.)	Toxicity
	Alkenes	EPA	Toxicity
	Allyl chloride	Executive Office of President	Toxicity
117-79-3	2-Amino Anthraquinone/dye	EPA	Toxicity
	Anthracene	Fish and Wildlife Service	Toxicity
	Antimony trioxide	OSHA	Toxicity
	Art hazards	National Endowment Humanities	Toxicity
1332-21-4	Asbestos	IRS	Toxicity/Carcinogenicity
	Asbestos	Congress (Rep.)	Toxicity/Carcinogenicity
	Asbestos	Environmental Defense Fund	Toxicity/Carcinogenicity
	Asbestos	Army	Toxicity/Carcinogenicity
	Asbestos	FDA	Toxicity/Carcinogenicity
	Asbestos	Defense Logistics Agency	Toxicity/Carcinogenicity
	Asbestos	Air Force	Toxicity/Carcinogenicity
	Asbestos	DOE	Toxicity/Carcinogenicity
	Asbestos	Department Commerce	Toxicity/Carcinogenicity
	Asbestos	Air Force	Toxicity/Carcinogenicity
	Asbestos	Pentagon	Toxicity/Carcinogenicity
	Asbestos	Department of Justice	Toxicity/Carcinogenicity
	Asbestos	Office General Council	Toxicity/Carcinogenicity
	Asbestos	U.S. Postal Service	Toxicity/Carcinogenicity
	Asbestos	Navy	Toxicity/Carcinogenicity
	Asbestos	EPA	Toxicity/Carcinogenicity
	Asbestos/encapsulation	U.S. Mint	Toxicity/Carcinogenicity
	Asbestos/ironer	VA	Toxicity/Carcinogenicity
	Asbestos/oropharyngeal cancer	HEW/PHS	Carcinogenicity
	Automobile repair shops	Reg. Air Pollution Control Agency	Toxicity
	Barium oxide	DOL/OSHA	Toxicity
	Benz(a)anthracene	EPA	Toxicity
	Benz(a)pyrene	Argonne National Laboratory	Toxicity

CAS Number	Chemical Name	Agency Requesting	Data Provided on Toxicity and/or Carcinogenicity
	Benzene	Executive Office of President	Toxicity
	Benzidine	Executive Office of President	Toxicity
	Benzo(a)pyrene	Executive Office of President	Toxicity
	Bis-chloromethyl ether (BCME)	Government Information Center	Toxicity
	Boric acid	HUD	Toxicity
	Brass foundry	Congress (Rep.)	Toxicity
98-73-7	p-tert-Butyl benzoic acid	Congress (Rep.)	Toxicity
75-91-2	t-Butyl hydroperoxide	Navy	Toxicity
614-45-9	t-Butyl perbenzoate	Navy	Toxicity
	Carbon	Air Force	Toxicity
	Carbon Black	USAEHA	Carcinogenicity
	Carbonless paper	USAEHA	Toxicity
	Carbonless paper	Navy	Carcinogenicity
	Carbonless paper	National Institute for Drug Abuse	Toxicity
	Carbon tetrachloride	Executive Office of President	Toxicity
	Carcinogens list trade names	Air Force	Carcinogenicity
	Carcinogens list	FDA	Carcinogenicity
	"Chemglaze"	NASA	Toxicity
	Chemicals/Laboratory	FDA	Toxicity/Carcinogenicity
57-74-9	Chlordane	USMC	Toxicity
	Chloroform	Executive Office of President	Toxicity
67-66-3	Chloroform	CDC	Carcinogenicity
	Chloroform	EPA	Toxicity
	Chloroform	USATHAMA	Toxicity
	Chromium/Reproduction	OSHA	Toxicity
	Chronic lung diseases/workers	Army	Toxicity/Carcinogenicity
	"Cibacron" dyes	DOL/OSHA	Toxicity
	Cleaning agents/stainless steel	Oak Ridge	Toxicity
	Coal Tar	DOE	Toxicity
7440-48-4	Cobalt	Navy	Toxicity
	"Coolex"	Congress (Rep.)	Toxicity
	Copper	VA Hospital	Toxicity
10380-28-6	Copper 8 Quinolinolate	Navy	Toxicity
	Cosmetologists	Congress (Rep.)	Toxicity/Carcinogenicity
8021-39-4	Creosote	TVA	Toxicity
	DBCP/sterility	EPA	Toxicity

CAS Number	Chemical Name	Agency Requesting	Data Provided on Toxicity and/or Carcinogenicity
	Decorated Glassware	FDA	Toxicity
	"De Solv It"	Congress (Rep.)	Toxicity
	"Destun"/herbicide	Fed. OSHA	Toxicity
	Diatomaceous earth	DOL/OSHA	Toxicity
	Dibenzylamine	Congress (Rep.)	Carcinogenicity
	Dibromotetrachloroethane	OSHA	Toxicity
	Dibutyltin dilaurate	Kennedy Space Center	Toxicity
	para-Dichlorobenzene	Army	Toxicity
20632-35-3	N'N'-Dichloro-bis (2, 4, 6-trichlorophenyl) urea	EPA	Toxicity
	Dichlorodifluoromethane	Executive Office of President	Toxicity/Carcinogenicty
	1, 2-Dichloroethane	EPA	Toxicity
75-09-2	Dichloromethane	US Coast Guard	Carcinogenicity
94-75-7	2, 4-Dichlorophenoxy acetic acid	Army	Toxicity/Carcinogenicity
	1, 3-Dichloropropane, 1, 2-Dichloropropane mixture	Executive Office of President	Toxicity/Carcinogenicity
542-75-6	1, 3-Dichloropropene	EPA	Toxicity/Carcinogenicity
	Diesel/underground	U.S. Bureau Mines	Toxicity
	Diesel/underground mines	MSHA Academy	Toxicity
104-78-9	Diethylaminopropylamine	Navy NEHC	Toxicity
	Diethylene glycol dinitrate	USAEHA	Toxicity
	Diethylene glycol n-butyl ether	OSHA	Toxicity
60-29-7	Diethyl ether	VA Med. Ctr.	Toxicity
	Diisocyanate	NASA	Toxicity
	Di-n-butyl-sebacate	Navy	Toxicity
	Dioctyl phthalate/teratogen	FRL	Toxicity
	Dioxane	NASA	Toxicity
	Dioxane	VA Med. Center	Toxicity
1746-01-6	Dioxin (TCDD)	EPA	Toxicity
122-39-4	Diphenylamine/teratogen	Navy	Toxicity
	Diphenyldimethylene diisocyanate with Freon 12	Navy	Toxicity
	Dithiocarbamates	FDA	Toxicity
	"Dizco-C-440"	OSHA	Toxicity
	Enflurane	VA Med. Center	Toxicity
	Ethylene Dibromide	Executive Office of President	Toxicity/Carcinogenicity
	Ethylene Dichloride	EPA	Toxicity/Carcinogenicity

CAS Number	Chemical Name	Agency Requesting	Data Provided on Toxicity and/or Carcinogenicity
	Ethylenedinitrilotetraacetic acid, tetrasodium salt	Executive Office of President	Toxicity/Carcinogenicity
	Ethylenimine	Executive Office of President	Toxicity/Carcinogenicity
	Ethylene Thiourea	Congress (Rep.)	Carcinogenicity
	Fiberglass	Navy	Toxicity
	Fiberglass	GSA	Toxicity
	Fiberglass/MEK peroxide catalyst	Navy	Toxicity
	Fiberglass plus catalyst	FAA	Toxicity
	Firefighters/Adenocarcinoma	Congress (Rep.)	Carcinogenicity
	"Fire-Trol 931L"	U.S. Forest Service	Toxicity/Carcinogenicity
	"Fire-Trol 934L"	U.S. Forest Service	Toxicity/Carcinogenicity
	"Fire-Trol 100"	U.S. Forest Service	Toxicity/Carcinogenicity
	Fluorocarbons	EPA	Toxicity
	Fly ash	Congress (Sen.)	Toxicity/Carcinogenicity
	Food Additives/fiber extenders	FDA	Toxicity
	Formaldehyde	OSHA	Toxicity/Carcinogenicity
	"Formnar"	NASA	Toxicity
	Freon	NASA	Toxicity
	Freon	U.S. National Archives	Toxicity
	Freon	U.S. National Archives	Toxicity
	Freon	NASA	Toxicity/Carcinogenicity
	Freon	VA Medical Center	Toxicity
	Freon gas	Department of State	Toxicity
	Freon 114 B2	OSHA	Toxicity
	Freon 1211	NASA	Toxicity/Carcinogenicity
75-43 4	Freon 21	NASA	Toxicity
149-91-7	Gallic acid	GDA	Toxicity
	Glioblastoma in Chemical Industry	OSHA	Carcinogenicity
	Graphite	Air Force	Toxicity
	Graphite dust	NASA	Toxicity
	Halon 1211	EPA	Toxicity
	Halon 2402	OSHA	Toxicity
	"Hebond"	EPA	Toxicity
	Helothane	VA Medical Center	Toxicity
	Hematologic/blood dyscrasias/ workers	FDA	Toxicity/Carcinogenicity

CAS Number	Chemical Name	Agency Requesting	Data Provided on Toxicity and/or Carcinogenicity
	Hexachlorobenzene	Executive Office of President	Toxicity/Carcinogenicity
	Hexachlorobutadiene	Executive Office of President	Toxicity/Carcinogenicity
	Hydrazine	Marshall Space Flight Center	Toxicity
	Hydrazoic acid	USA/EHA	Toxicity
128-37-0	Ionol (BHT)	Congress (Rep.)	Toxicity
	Insecticides/spraying international flights	PHS	Toxicity
	Iron oxides	FDA	Toxicity
	"Isocrete"/peripheral neuropathy	VA Hospital	Toxicity
	Isocyanates	Air Force	Toxicity
	"Isopar H"	HEW/SSA	Toxicity
120-58-1	Isosafrole	Drug Enforcement Adm.	Toxicity/Carcinogenicity
	Kodak-Dektol developer	EPA	Toxicity
	Kodak-Developer D-11	EPA	Toxicity
	Kodak-Ektamatic A-10 Activator	EPA	Toxicity
	Kodak-Ektamatic S-30 Stabilizer	EPA	Toxicity
	Kodak-Fixer	EPA	Toxicity
	Kodak-HRP Developer	EPA	Toxicity
	Kodak-Photo-Flo 200	EPA	Toxicity
	Kodak-Ektamatic SC Paper	EPA	Toxicity
	Kodak-Kodabrome II RC Paper	EPA	Toxicity
	Lead	OSHA	Toxicity
	Lead	CDC	Toxicity
	Lead/toxic synergism chemicals	US PHS Hospital	Toxicity
	Leather/Tanning Industry	OSHA	Toxicity
142-16-5	Maleic acid, bis-(2-ethylhexyl) ester dioctyl-maleate	Navy NRMC	Toxicity
	MDA	Marshall Space Flight Center	Toxicity
	MDI	Air Force	Toxicity
	Melamine formaldehyde	NASA	Toxicity
	Malamine resins	NASA	Toxicity
	Mercury	EPA	Toxicity
	Methylene chloride	VA Hospital	Toxicity
75-09-2	Methylene chloride	DHEW/PHS	Toxicity
26446-71-9	4, 4-Methylenedianiline	Marshall Space Flight Center	Toxicity
	$MgCl_2$	EPA	Toxicity

CAS Number	Chemical Name	Agency Requesting	Data Provided on Toxicity and/or Carcinogenicity
	MICA	FDA	Toxicity
	Myrex/fire ants	EPA	Toxicity
	Nickel	EPA	Carcinogenicity
	Nickel carbonyl	EPA	Carcinogenicity
	Nickel carbonyl	DOE	Toxicity
	5-Nitroanisidine	EPA	Toxicity
	Nitro-cellulose based films	GSA	Toxicity
	2-Nitro-diphenylamine	Navy	Toxicity
	Nitrosamines	TVA	Carcinogenicity
	Nitrosamines	OSHA	Carcinogenicity
	Nitrosamines	Navy	Carcinogenicity
	Nitrous oxide	VA Medical Center	Toxicity
	Oleic acid, methyl ester, cis	National Center Toxicology Res.	Toxicity
	Orange-Sol	EPA	Carcinogenicity
	OSHA list carcinogens	VA Hospital	Carcinogenicity
	OSHA list carcinogens	DOL/OSHA	Carcinogenicity
20816-12-0	Osmium tetroxide	VA	Toxicity
	"Oxgem"	Congress (Rep.)	Toxicity
	Ozone	GSA	Toxicity
	Ozone	Army	Toxicity
	Ozone/Multiple Sclerosis	OSHA	Toxicity
	Paints & Thinners	Congress (Sen.)	Toxicity
	Palanil dye/dermatitis	DOL/OSHA	Toxicity
	PAN (Poly acrylonitrile)	Air Force	Toxicity
106-46-7	Paradichlorobenzene	EPA	Toxicity
	Paraquot/pesticide	EPA	Toxicity
	PCB	Congress (Rep.)	Toxicity
	PCB	U. S. Bureau of Standards	Toxicity
122-54-6	2, 4 Pentanedione	Navy	Toxicity
	Penthrane	VA Medical Center	Toxicity
	Perchloroethylene	Congress (Sen.)	Toxicity
	Perchloroethylene	EPA	Toxicity
	Perchloroethylene	Navy	Toxicity
3164-46-3	N-Phenethylaziridine	Navy	Toxicity
	Phenol	FDA	Carcinogenicity
	Phenol	Navy	Carcinogenicity

CAS Number	Chemical Name	Agency Requesting	Data Provided on Toxicity and/or Carcinogenicity
	Phenyl-alpha-naphthylamine	Congress (Rep.)	Carcinogenicity
	Phenyl-alpha-naphthylamine & Diphenyl-para-phenylenediamine	Congress (Rep.)	Carcinogenicity
25-265-76-3	Phenylenediamine	Marshall Space Flight Center	Toxicity
	"Phos-Chek 259"	U.S. Forest Service	Toxicity
	"Phos-Chek XA"	U.S. Forest Service	Toxicity
	Photographic Dark Room Hazards	OSHA	Toxicity
	Picronic Acid	Navy	Toxicity
	Polychlorinated biphenyls	Navy	Toxicity
	Polyethylene/Plastic wrap	GSA	Toxicity
	Polyethylene/Shrink wrappers	HEW	Toxicity
	Polyhalegenated biphenyls	Executive Office of President	Toxicity
	Polystyrene foam vapor	Fed. Information Center	Toxicity
359-11-5	Polytetrafluoroethylene (Teflon)	Navy	Toxicity
	Polyvinyl formal resin	NASA	Toxicity
	Pottery Clay	OSHA	Toxicity
	Printing/Photography/Chemicals	U.S. Department of Agriculture	Toxicity
6423-43-4	1,2-Propylene glycol dinitrate	Navy	Toxicity
	"Prestone"	MSHA	Toxicity
	Prestone/Zerex	MSHA	Toxicity
1336-36-3	Pyranol	U.S. Penitentiary	Toxicity
	Pyridines	FDA	Toxicity
	Pyrocatechol, 4-tert-butyl	Navy	Toxicity
	Red dyes/hepatitis	VA Hospital	Toxicity
	Rock wool	DHEW (Office of Secretary)	Toxicity
62-73-7	Shell's No Pest Strip	EPA	Toxicity
7631-86-9	Silica, Amorphous, Fuses	Navy	Toxicity
	Silica, Amorphous, Hydrated	Navy	Toxicity
	Silkscreen/vapors/hazards	U.S. Embassy	Toxicity
	Smoking	Congress	Carcinogenicity
	"Sorbent-C"	Air Force	Toxicity
	"SR 2"	Congress (Rep.)	Toxicity
	Sudan Red 7-B	National Heart & Lung Institute	Toxicity/Carcinogenicity
	"Swedish cement"	DOL/OSHA	Toxicity
	Talc/Tremolite Dust	Navy	Toxicity/Carcinogenicity
	TDI (Toluene diisocyanate)	Army	Toxicity

CAS Number	Chemical Name	Agency Requesting	Data Provided on Toxicity and/or Carcinogenicity
	Tellurium	NASA	Toxicity
	Tetrachloroethylene	U.S. Coast Guard	Carcinogenicity
78-00-2	Tetraethyl Lead	Coast Guard	Toxicity
	Thermal insulating cement/asbestos	Army Corps. of Engineers	Toxicity
	Thorium oxide	Congress (Rep.)	Toxicity
	Tobacco manufacturing process	NCI	Toxicity
	Toluene	VA Hospital	Toxicity
	1, 1, 1-Trichloroethane	EPA	Toxicity
	1, 1, 1-Trichloroethane	NASA	Toxicity
	1, 1, 1-Trichloroethane	NASA	Toxicity
	Trichloroethylene	NASA	Toxicity
	Trichloroethylene	NASA	Toxicity
	Trichloroethylene	OSHA	Toxicity
	Trichlorofluoromethane	Executive Office of President	Toxicity
	Tricresyl phosphate	Executive Office of President	Toxicity
	Triethylene glycol dinitrate	USAEHA-Aberdeen	Toxicity
	Trimetriolethanetrinitrate	USAEHA-Aberdeen	Toxicity
118-96-7	2, 4, 6-Trinitrotoluene (TNT)	Navy	Toxicity
121-82-4	1, 3, 5-Trinitro-1, 3, 5-triazocyclohexane (RDX)	Navy	Toxicity
7440-61-1	Uranium	DHEW/PHS/Indian Health Service	Carcinogenicity
	Uranium	DHEW/PHS/Indian Health Service	Carcinogenicity
	Uranium	Army	Toxicity
	Urea formaldehyde	NASA	Toxicity
	Vapor degreasing	OSHA	Toxicity
	Vinyl Chloride	FDA	Toxicity
	Vinylidene Chloride	VA Hospital	Toxicity
88-12-0	N-vinyl pyrrolidone	Navy	Toxicity
	Zinc	VA Hospital	Toxicity
1328-67-2	Zinc chromate	NEHC/Navy	Carcinogenicity
	Zinc naphthenate/handling	Navy	Toxicity

APPENDIX I

AGENCY ELABORATIVE STATEMENTS
ON
REGULATORY MISSION

CONSUMER PRODUCT SAFETY COMMISSION

Received November 17, 1979

Consumer Product Safety Commission Submission to First Annual Report on Carcinogens

The Consumer Product Safety Commission is submitting data on the following chemicals, in response to the approach adopted by the National Toxicology Program (NTP) staff for preparing the first annual report on known and potential human carcinogens to which a significant number of persons in the U.S. are exposed:

Abestos
Benzene
Benzidine, and benzidine-based dyes and pigments
Vinyl chloride
2-Naphthylamine
Arsenic Trioxide
Auramine
Cadmium (elemental)
Cadmium sulfate
Cadmium sulfide
Calcium chromate
Chromic oxide
Chromium (elemental)
Chromium dioxide
Sodium dichromate
*Acrylonitrile
*Polyvinyl chloride
*Polyvinyl pyrrolidone
*Tris (2-3 dibromopropyl) phosphate

The NTP staff and Executive Committee representatives agreed that the first annual report would consist of those chemicals and processes (57) on two lists extracted from the chemicals reviewed in Volumes 1-16 of the IARC Monographs on Cancer. These chemicals or processes either have been associated with the induction of cancer in humans or are considered to be potential human carcinogens. In addition, it was agreed to include in the report all chemicals not on these two lists for which the regulatory agencies on the Executive Committee have promulgated regulations as a result of their carcinogenic potential.

Accordingly, all of the chemicals for which the Commission has submitted data are drawn from the two lists except for Tris (2,3-dibromopropyl) phosphate (TRIS) which was shown to be carcinogenic in rats and mice in an NCI two year carcinogenesis bioassay and which was shortly thereafter regulated by the Commission.

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* Will be included in the Second Annual Report on Carcinogens

All of the chemicals in the Commission submission are either known or suspected to occur in consumer products. With respect to cadmium and chromium and compounds containing each of these elements, the Commission has submitted data on each of the elements, and on those compounds, listed in the IARC reviews for which consumer product usage has been determined or is suspected. In addition, the Commission has submitted use and exposure data on benzidine-based dyes and pigments as well as on benzidine itself.

The data submitted by the Commission is presented in two formats;

1) In the appropriate columns of the suggested worksheet for reporting information on environmental carcinogens, which was supplied by the NTP staff;

2) On summary sheets for individual chemicals where sufficient data exist and in a summary table of data on chemicals lacking adequate data, both of which have been designed to address the unique issues facing the Commission regarding human exposure to chemicals as they occur in a wide variety of consumer products.

The Commission believes that the worksheet approach will provide a good summary of use, exposure and regulatory status data for the chemicals in the annual report. However, for each chemical in the report, the data relating to a given agency's jurisdiction should be shown individually for each agency making a submission. This would give a capsule description of the types of data utilized by the various agencies and how these data influence the regulatory stances taken.

During the time period in which the Commission was formulating its interim cancer policy, Commission staff also developed a process for monitoring the marketplace to identify candidates for regulation. This process is designed not only to ascertain the presence in consumer products of chemicals demonstrated to have carcinogenic potential, but also to gather detailed economic data such as the amount and form of the chemical in each product class. Additionally the process includes investigations into the potential for consumer exposure to potentially carcinogenic compounds in various product classes. Not only must the Commission conclude on the basis of scientific data whether a given chemical is a potential human carcinogen, it must also determine whether exposure to various types of consumer products containing that chemical can pose a hazard. Carcinogenic potential of the chemical alone does not provide a sufficient basis for regulation of consumer products containing that chemical. For each product class containing that given chemical, a determination must be made as to whether the potential for human exposure to that chemical exists, either by ingestion, inhalation or skin absorption.

To date most of the chemicals in the first sixteen volumes of the IARC Monographs have been screened as well as a large number of other chemicals, including many of those for which Final Reports from the NCI Bioassay Program are available. This ongoing process is an interdisciplinary one involving staff from the health sciences, economics and information specialist divisions. Each month additional chemicals are screened and entries made into the Commission's data base. This step-by-step process is designed to enable the Commission to intelligently select for action the most serious of the thousands of potentially hazardous chemicals in use today. An additional offshoot of this system is the generation of more detailed data for inclusion in the annual report on carcinogens.

The Commission considers the screening system to be an important regulatory program in the chronic hazards area since it not only identifies chemicals which pose toxicological hazards but also isolates those products which need Commission action. The type of action varies with the products involved and can range from negotiated voluntary agreements to outright bans.

Likewise, this process eliminates from further consideration those chemicals which either are judged not to constitute a hazard or are not found in consumer products, and those products containing carcinogenic substances for which there is no significant potential for exposure. In this fashion the system can also inform the public and industry when regulatory action is not appropriate.

By statute the annual report must concentrate on use, exposure and regulatory status data. However, as noted above, reductions in exposure to, or cessation of use of, a potential carcinogen in certain consumer products can be effectuated by negotiated agreements and voluntary actions without the need to issue standards or regulations. The Commission considers such actions as an important alternative to mandatory regulation in many instances. A topical and relevant example involves events following the revelation in March 1979, of the use of asbestos in hand held hair dryers. Upon receipt of test results from a private laboratory indicating not only that several hair dryer models contained asbestos but that release of respirable fibers might occur, the Commission acted rapidly and decisively. Within a period of approximately six weeks, the Commission issued Special Orders on three separate occasions to about 150 manufacturers and private labelers, held two public meetings, and approved Corrective Action Plans by 11 firms representing 90 percent of all domestic hand held dryer production. These firms voluntarily agreed to halt further sale of hair dryers containing asbestos and to repair or replace an estimated five million hair dryers already in the possession of consumers. During the months of April and May, 1979, the Commission received approximately 150,000 Hotline calls and 100,000 letters requesting information on asbestos in hair dryers. Inquirers were told whether their units contained asbestos, where information was available, and what actions they could take. More recently in October, 1979, the Commission approved Corrective Action Plans by an additional 26 firms. These represent about 10 percent of the market, thereby bringing market coverage to essentially 100 percent.

Another example in which use patterns have been altered without the issuance of a final regulation involves the use of benzene in consumer products. In May, 1978 the Commission published a proposal to ban the intentional addition of benzene to consumer products and to limit the concentration of benzene as a contaminant in consumer products to levels of less than 0.1 percent by volume. Subsequent to the issuance of this proposal, economic studies performed for the Commission demonstrated the cessation of use of benzene as an intentional ingredient in consumer products. In this case, the intent to regulate may have been sufficient to achieve the elimination of the remaining intentional use of this chemical.

Voluntary programs and negotiated agreements only constitute a limited fraction of the effort needed to reduce exposure to known and potential human carcinogens. However, CPSC believes it particularly appropriate to include in the annual report on carcinogens the negotiated agreements and voluntary programs undertaken by the regulatory agencies, and their impact.

As a final comment, the Commission recommends the establishment of a set of criteria for determining for future reports not only which chemicals are of sufficient concern to warrant inclusion in the report, but also what constitutes a significant degree of exposure to persons in the U.S. Perhaps the criteria enunciated both in the IRLG Risk Assessment Workgroup document entitled "Scientific Bases for Identification of Potential Carcinogens and Estimation of Risks", and in the Regulatory Council's cancer policy, could serve as the basis for developing NTP criteria for use in selecting chemicals for inclusion in subsequent Annual Reports. The choice of the chemicals reviewed by IARC served as a useful first step for developing the initial report, particularly in view of the various time constraints, but a systematic approach would be useful in the future. An outgrowth of developing and utilizing such criteria could be the more rapid identification of those chemicals suspected to be carcinogenic but in need of further testing. Such testing could then be initiated under the NTP.

THE ENVIRONMENTAL PROTECTION AGENCY

Received March 27, 1980

(1) Statutes involved in this report are abbreviated, as follows:

Clean Air Act = CAA
Clean Water Act (Federal Water Pollution Control Act) = CWA
Safe Drinking Water Act = SDWA
Federal Insecticide, Fungicide, and Rodenticide Act = FIFRA
Toxic Substances Control Act = TSCA
Resource Conservation and Recovery Act = RCRA
Atomic Energy Act = AEA
Federal Food, Drug, and Cosmetic Act = FFDCA

Numbers, when given, refer to sections of the appropriate Act.

(2) Water Quality Criteria (CWA, 304) (a)) are issued to serve as guidance for the States to use in establishing Water Quality Standards. To the extent that the States adopt numerical standards, these are usually in the same stringency range as the criteria. It should be noted that States do not always adopt numerical standards for the chemicals for which criteria are published. The Water Quality Criteria identified in this report have been proposed, and are thus subject to revision before final publication.

(3) Effluent Guidelines (CWA, 301) have been developed for several parameters and industrial categories. Guidelines relevant to this report address arsenic, cadmium, and chromium, and have been developed for the asbestos industry. The organic chemicals contained in this report would be included by parameters addressing such measurements as total organic carbon, oil and grease, and total suspended solids. These guidelines serve as the basis for National Pollutant Discharge Elimination System (NPDES) permits (CWA, 402), issued by EPA Regional Offices and the States. These permits must be written for each discharge source, whether it belongs to an industrial category for which effluents guidelines have been issued or not. The officials issuing NPDES permits have discretion to incorporate provisions limiting discharge of any problem chemical.

(4) Toxic Pollutant Effluent Standards (CWA, 307 (a)) were issued in 1977. Enforcement and trend data are not centrally available.

(5) Hazardous Spill Regulations (CWA, 311) are not based on carcinogenicity considerations, because they are designed to respond to short-term emergencies, rather than chronic exposures. They are designed to promote greater care in handling and shipping of chemicals; however, the regulations have not been in effect long enough to determine their impact on reducing chemical spills.

(6) Assessments for possible regulation of carcinogens under National Emission Standards for Hazardous Air Pollutants (NESHAP) (CAA, 112), address chemicals generally accepted to present strong carcinogenic potential as air pollutants. EPA is developing a generic approach to regulation of these substances, and others to be designated in the future. The generic rule was proposed in October 1979, and evaluation of comments before promulgation is expected to take at least a year. Therefore, the earliest that a generic listing of chemicals for regulation could be expected is late 1980 or early 1981. Although EPA expects to regulate most air carcinogens using this generic rule, this does not eliminate the possibility that special, chemical-specific regulations may have to be written.

(7) Assessment of air pollution sources and implications (CAA) usually addresses carcinogenicity, as well as other risks. Such assessments may or may not result in regulation.

(8) Pesticide activities are generally self-explanatory. Any assessments include consideration of carcinogenic potential; these entries are identified under FIFRA, 6.

(9) Assessments of drinking water contaminants (SWDA) are performed by the National Academy of Sciences. The Office of Drinking Water performs additional assessments before determing the necessity for and propriety of establishing regulations.

(10) Preregulatory reviews (TSCA) of chemicals are generally the first stage of assessment for possible regulatory concern. These listings are included to demonstrate that EPA has compiled readily available information on these chemicals.

(11) Assessments of sources and effects (TSCA) are more detailed studies of risks and exposure potential of chemicals. These are likely to result in a regulatory decision, which could include "no regulation" or "referral to another regulatory authority under the provisions of Section 9."

Notes on Production Data Derived from the Initial TSCA Section 8(b) Inventory of Chemicals in Commerce

(1) Confidentiality--Production volume figures may have been claimed as Confidential Business Information (CBI) by one or more manufacturers of a substance reported for the Inventory. When this happens frequently, no production volume figures are revealed in the "public" data base for that chemical.

(2) Exclusions--Not all chemical substances are included on the Inventory. Excluded are: mixtures, naturally occurring substances, radioactive substances subject to the Atomic Energy Act, pharmaceuticals, food additives, tobacco, cosmetics, pesticides, and chemicals still in research and development.

(3) Errors--Many errors could have occurred in reporting, through misinterpretation of the regulations, failure to report, or errors in ADP input/output.

(4) Imprecise Identity--There were difficulties in matching the names and CAS numbers given on the HEW lists of 57 and in the IARC monographs with corresponding chemical names and CAS numbers in the TSCA Inventory. The TSCA Inventory is probably the most precisely identified large list of chemicals ever assembled. Matching imprecisely identified chemicals or groups of chemicals against the more precise Inventory presents some problems.

(5) Complex Chemical Substances--Less than one-half of the chemicals listed on the Inventory are chemicals with a unique, precisely defined structure. Many are "Class 2" chemicals which have some degree of variability in structure, ranging from a small degree to "UVCB's"--Unknown or Variable Composition, Complex Reactions Products, and Biologics. A UVCB cannot be identified with a single molecular formula. A typical example is CAS number 65996-93-2, coal tar pitch.

Furthermore, some substances such as benzene (CAS number 71-43-2) are frequently components of UVCBs. A retrieval from the Inventory based only on the benzene CAS number of 71-43-2 will yield a gross underestimation of the actual amount of benzene produced in this country. Estimates of the extent of this underestimation could vary from a factor of two to a factor of as much as one hundred.

FOOD and DRUG ADMINISTRATION

Received January 8, 1980

The Food and Drug Administration is charged with enforcing laws concerned with protecting the public from the possible harmful effects of human drugs, food additives, food contaminants, animal drugs that may contaminate edible animal products, cosmetics, and medical devices*. Under its mandates, the Agency is concerned about _any_ possible risks associated with human exposures to these classes of substances, not only risks of cancer. And, but with one exception (food additives), the applicable laws do not distinguish cancer from other types of health risks.

Under the law, these various classes of substances are treated in different ways. Accordingly, FDA must consider the underlying Congressional mandates whenever it considers the proper regulatory course. Thus, although FDA may find that the risks from a food contaminant and an intentional food additive (both to be defined below) are comparable, regulation of these substances may, and most probably will, differ because Congress has made different value judgments about these two classes of hazard. Following are the general considerations that enter into FDA regulatory decision-making for each of the above classes of regulated substances.

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*The FDA also has regulatory authority over biological products, such as vaccines, and radiation-emitting devices. Neither of these classes of products are treated in this report.

(1) Food Additives: Any substance, the intentional use of which results in its becoming a component of food, is a member of this class. The class includes substances directly added to food as well as those that might indirectly enter food because of their presence in food contact materials (e.g., packaging). All members of this class require premarket testing for safety before they can be approved. Under the law, any such substance found to be a carcinogen can not be approved for use. Any approved substance found to be carcinogenic in new tests performed after its initial approval must be banned from the food supply. No benefit consideration is permitted.

(2) Food Contaminants: Some substances may enter the food supply because they are general environmental contaminants (e.g., PCBs) or because they are natural by-products of the growth of certain micro-organisms on food (e.g., aflatoxin). If such substances occur with regularity as food contaminants, FDA establishes regulations to limit the amount of such substances that may be present in food. Complete elimination of such substances would require complete elimination of the basic food commodity. Under the law, the agency must limit substances that cannot be avoided by good manufacturing practices to the extent necessary for the protection of the public health. For each such substance, FDA considers technical questions bearing on its avoidability, capabilities for analyzing the amount present, and health effects. No premarket testing is required for such substances. Before taking regulatory action, FDA must bring forth evidence showing that a substance may be harmful and must determine the degree of possible avoidability.

(3) Natural components of food. Under the law, such substances can be prohibited or restricted if FDA can make a showing that they present a health risk at the level at which they are ordinarily present in food.

(4) Animal drugs that may contaminate edible animal products. Under the law a carcinogen can be used as an animal drug only if, under its conditions of use, "no residue" of the drug is detected in edible animal products. FDA has the authority to approve a method of analysis that will serve to define the condition of "no residue". The method must have premarket approval from FDA.

(5) Human drugs. Regulation of human drugs takes into account the health risks of not having a drug available against the risks that the drug pose. Thus, a benefit-risk standard is the dictate of law. Premarket approval is required.

(6) Cosmetics. Under the law the FDA must come forward with evidence that, under normal conditions of use, a cosmetic may be hazardous to health before regulatory action can be contemplated (i.e., no premarket testing for safety is required). Action may take a variety of forms, depending on the strength of evidence of risk.

(7) Medical Devices. Regulation of medical devices takes into consideration both benefit and risk in approving or disapproving a medical device. The Bureau of Medical Devices has been in existence since 1976 and has at present only established what products are under its jurisdiction. Safety Review of these products is underway and specific regulations and actions will be undertaken after consideration of benefit vs. risk.

In responding to the requirements of the McGuire Amendment, FDA has selected all substances from the list of carcinogens chosen for examination that come under its regulatory authorities. If there is no FDA related information shown for a substance on the list, then it can be assured that it does not fall under FDA authorities.

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

Received April 11, 1980

OSHA and NIOSH Maguire Amendment Statement

The Agencies believe that occupational carcinogen standards require a complete system of control. Regulation of exposure to carcinogens in the workplace must go beyond a simple exposure limit, however carefully considered. During the past eight years, OSHA has devoted considerable resources to the promulgation of specific carcinogen standards including asbestos, B-naphthylamine, benzidine, vinyl chloride, coke oven emissions, arsenic, and acrylonitrile among others.

In each case a number of types of controls have been instituted. They include, in various combinations, environmental monitoring, medical surveillance, worker shower and locker facilities, training and education, personal protective equipment, emergency procedures, mandatory process controls, labeling and hazard signs, written notification of exposure, and waste disposal rules. Each of these individual standards requirements reinforces the others and contributes to better overall protection of the worker, through reduced exposures and better knowledge of hazards and how to avoid or control them. In most cases a numerical exposure limit, which is a specific level to which the work environment must be controlled, is also set. However, this represents only one part of a comprehensive program of standards.

In a number of cases, such as asbestos, vinyl chloride, and coke oven emissions, various federal courts have issued final decisions that OSHA's interpretation of a carcinogen standard as a system of control is appropriate and necessary.

It is important to point out that when a permissible level for exposure (PEL) to a carcinogen is set by OSHA, there is no implication that such a level is safe. To the contrary, it is the agency's policy that any occupational exposure to a carcinogen carries with it some risk of disease, even if it cannot be easily or precisely measured. A number of factors are considered in setting such permissible exposure limits, including the availability of accurate and reproducible analytic methods for environmental monitoring, the technological feasibility of various engineering or process controls, the availability of acceptable substitutes and, in a broad way, the economic feasibility of controls. All of these complex considerations are in the end reduced to a single feasible number. Occupational exposure should be kept lower than the PEL if possible, but in no case is it allowed to be higher.

The standards setting process for individual substances is a long and complicated one with substantial opportunity for full public participation and the right of legal review, both of which have been extensively used. A published proposal, an informal public hearing, opportunities to testify and question witnesses during OSHA's standards setting hearings, and the right to submit written comments afford any interested parties with an adequate chance to present their views in detail.

For those substances, including carcinogens, for which complete health standards have not yet been established there are, however, other specific means of control under the Occupational Safety and Health Act. The foremost among them is probably the 'general-duty' clause of the Act, Section 5.(a)(1) which reads:

> Each employer shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are likely to cause death or serious physical harm to his employees.

In the case of carcinogens this means that where a hazard is generally recognized the employer must provide appropriate protection even in the absence of a specific individual substance standard. There are a number of ways in which a hazard may become generally recognized. The National Institute for Occupational Safety and Health (NIOSH) has published a series of over 100 criteria documents which include a detailed review of health effects data and a series of 33 Current Intelligence Bulletins (CIB's) containing important new information on occupational hazards, including many newly-discovered carcinogens, which are widely distributed to industry and the professional occupational health community. If an expert group such as the International Agency for Research on Cancer (IARC) reviews a chemical and classifies it as a carcinogen that opinion carries considerable weight. OSHA has on occasion produced Health Hazard Alerts which provide notice of substantial health hazards or risks, and are sent to concerned parties and released to the public. Positive results from industry-sponsored toxicology or epidemiological studies may be sufficient. Industry may provide guidance concerning carcinogenic potential through their trade associations and journals. Through many combinations of these and other forms of notice, a carcinogen may become a generally recognized hazard, thus imposing the 'general duty' clause burden of protection on an employer. While the specific control methods necessary are not spelled out in such a case, the general pattern of control for most carcinogens OSHA regulates is consistent, and there should be little question about an appropriate protection program.

Beyond the 'general duty' clause there are other specific protections in the Act which may help control worker exposure to carcinogens.

These include a worker's right to request a workplace inspection by OSHA, to request an industrial hygiene or medical evaluation of a workplace hazard or problem from NIOSH, and the right to petition the Secretary of Labor for new health standards.

There are several initiatives under way by OSHA to offer additional protection to workers exposed to carcinogens. OSHA's Cancer Policy is the Agency's attempt to streamline the process of setting individual cancer standards. The standard states plainly the fundamental scientific principles of carcinogenesis research which will be used in the standards setting process until the scientific consensus changes, the criteria for classifying carcinogens, and the appropriate abatement actions for workplace exposure to carcinogens. The Standard for Worker Access clearly defines rights generally stated in the Act for workers to have access to monitoring and personal medical records and other medical data. A fully informed worker is better able to take positive steps to protect his or her health, and assist in the control of workplace exposure to carcinogens.

Finally, there are a number of other was in which OSHA and NIOSH can help to reduce unnecessary exposure to carcinogens and reduce the burden of occupational cancer. For example, the Agencies participate in the National Toxicology Program (NTP) and, through their votes on the Executive Committee and membership on the Chemical Selection Subcommittee, have a direct voice in the selection of particular chemicals of occupational health concern for lifetime bioassay testing by the federal government. The interval during which a chemical is first suspected to pose a potential occupational cancer hazard and when it is put on test has been considerably reduced. It is expected that earlier detection, confirmation, and control of occupational cancer hazards will result. NTP programs in other areas of toxicology, including short-term testing, also hold promise of such future benefits. Combined efforts of which OSHA is a part, such as the formulation of the Interagency Regulatory Liaison Group's (IRLG) joint statement on Risk Assessment, should ensure a consistency of regulatory approach, and allow limited toxicology resources to be spent on additional problems, thus also speeding the ultimate reduction of occupational cancer risk.

APPENDIX II

GLOSSARY

GLOSSARY OF ABBREVIATIONS AND TERMS COMMONLY USED IN THIS REPORT

Analgesic - A pain reliever

Anon. - Anonymous

ANPR - Advanced Notice of Proposed Rulemaking

Antipyretic - An agent that relieves or reduces fever

Antirickettsial - An agent that is effective against rickettsiae, a family of microorganisms transmitted by lice, fleas, ticks, and mites

BATF - Bureau of Alcohol, Tobacco, and Firearms
Department of Treasury Agency

BCME - Bis-(chloromethyl)ether

BF - Bureau of Foods
Bureau of the Food and Drug Administration

BMD - Bureau of Medical Devices
Bureau of the Food and Drug Administration

BW - Body Weight

CAA - Clean Air Act

°C - Degree centigrade

CAS - Chemical Abstract Service
A division of the American Chemical Society that abstracts and indexes the world chemical literature. All chemicals referenced in the literature are assigned CAS registry numbers.

CDC - Center for Disease Control

CFR - Code of Federal Regulations

C.I. - Color Index
Society of Dyers and Colorists provides a numbered index for dye identification

CMME - Chloromethyl methyl ether

CO_2 - Carbon dioxide

CPSA - Consumer Product Safety Act (1972)
A statute defining some of the responsibilities of the Consumer Product Safety Commission (CPSC)

CPSC - Consumer Product Safety Commission

Cr (VI) - Chromium, hexavalent

CSSG - Chemical Selection Subgroup of the Clearinghouse on Environmental Carcinogens (NCI)

CSPG - Chemical Selection Planning Group of NCI

CSWG - Chemical Selection Working Group (NCI)

CWA - Clean Water Act
Title assigned to the 1977 amendments of the Federal Water Control Act

De minimus - The least

DES - Diethylstilbestrol

DHEW - Department of Health, Education and Welfare; now the Department of Health and Human Services and the Department of Education

DOE - Department of Energy

DOL - Department of Labor

EPA - Environmental Protection Agency

et al - And others

Et Seq. - Et Sequens - that which follows

F - Farenheit

FAA - Federal Aviation Administration

FDA - Food and Drug Administration

FDCA - Food, Drug, and Cosmetic Act (1938)
One of the statutes defining the responsibilities of the Food and Drug Administration (FDA).

FHSA - Federal Hazardous Substances Act (1966)
A statute defining some of the responsibilities of the Consumer Product Safety Commission (CPSC).

Fibers/cc - Number of fibers per cubic centimeter
A term of spatial measurement for the numbers of fibers in a cubic centimeter (about a thimbleful) of air.

FIFRA - Federal Insecticide, Fungicide, and Rodenticide Act

FY - Fiscal year
The fiscal year of the U.S. Government is October 1 to September 30.

FR - Federal Register
The official organ of the U.S. Government; published every working day

GSA - General Services Administration

hr - Hour

IARC - International Agency for Research on Cancer
An agency of the World Health Organization (WHO) with headquarters in Lyon, France

IM - Intramuscular; into the muscle
Usually describes a route of injection

Insol - Insoluble

IP - Intraperitoneal; into the abdominal cavity
Usually describes a route of injection

ITC - Interagency Testing Committee - Established under Section IV of TSCA

IV - Intravenous; into the vein
Usually describes a route of injection.

mg/kg - Milligrams per kilogram

mg/L - Milligrams per liter
A term of volumetric measurement. A milligram is 1/1,000 of a gram; about 1/28,000 of an ounce; a liter is slightly more than a liquid quart.

mg/m^3 - Milligrams per cubic meter
A term of spatial measurement. A milligram is about 1/28,000 of an ounce; a cubic meter is roughly 1-1/3 cubic yards.

MHSA - Mining, Health and Safety Administration

min. - Minute

Mol. wt. - Molecular weight

mppcf - Millions of particles per cubic foot

NASA - National Aeronautics and Space Administration

ng - Nanogram = one billionth of a gram

NCI - National Cancer Institute

NESHAP - National Emission Standards of Hazardous Air Pollutants

NIEHS - National Institute of Environmental Health Sciences

Ni - Nickel

NIH - National Institutes of Health

nil - Nothing

NIOSH - National Institute for Occupational Safety and Health

NMRC - Navy Medical Research Center

NOHS - National Occupational Hazard Survey

NPDES - National Pollutant Discharge Elimination System

NTP - National Toxicology Program

OSHA - Occupational Safety and Health Administration

O.T.C. - Over-the-counter
Non-prescription drugs.

PAH or PNAH - Polynuclear aromatic hydrocarbons
A specific class of chemical compounds produced by the incomplete combustion of coal, petroleum, or other carbon-containing substances.

PEL - Permissible Exposure Limit

PHS - Public Health Service

PL - Public Law

ppb - Parts per billion

ppm - Parts per million

PPPA - Poison Prevention Packaging Act

PVC - Polyvinyl chloride
A polymerized form of vinyl chloride monomer.

RPAR - Rebuttable Presumption Against Registration

Sol. - Soluble/Solubility

SC - Subcutaneous

SFR - Standard Federal Regulations

SUS - Saybolt Universal Seconds

TVA - Tennessee Valley Authority

TSCA - Toxic Substances Control Act

TWA - Time Weighted Average
A factor used in determining or limiting workplace exposure to a substance.

ug - Microgram = 1/1,000,000 gram

ug/kg - Microgram per kilogram

um/m^3 - Millimicron per cubic meter

USDA - United States Department of Agriculture

V (vol) - Volume

VA - Veteran's Administration

VC - Vinyl chloride

VCM - Vinyl chloride monomer
Monomers are the building blocks from which polymers are made. Vinyl chloride monomer is the starting material for polyvinyl chloride.

WHO - World Health Organization

wt. - Weight

yr. - Year

10^2, 10^3, 10^6, etc. - 10^2, for example, is 10 x 10 (or 100); 10^3 is 10 x 10 x 10 (or 1,000)

Appendix III

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